Machinery of the Heavens

BY

A. P. Pichereau.

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MACHINERY

OF THE

HEAVENS.

A SYSTEM OF PHYSICAL ASTRONOMY.

BY

A. P. PICHEREAU.

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CONTENTS.

PAGE.

Introductory Letter,.....

Illustration—Our Solar System ..

Essay I—The Reason why the Earth Rotates on its Axis .. 1 to 26

Essay II—The Reason why the Earth Revolves around the Sun and why the Moon Revolves around the Earth..... 28 to 49

Essay III—Comets—Their General Forms and Motions.. 50 to 67

Essay IV—Production and Destruction of Worlds..... 68 to 86

Essay V—Philosophy of the Tides.. 87 to 101

Philosophical Chips—From the Author's Recent Lectures and Debates .....102 to 142

INTRODUCTORY LETTER.

To The Reader:

I take up my pen to say a few words to you before you read the contents of this work, which has been called "Machinery of the Heavens."

When I first undertook to discover some of the laws, that govern a few of the motions in our solar system, I never expected to continue as I have continued. I simply meant to make some repairs, but before I was through, I thought that I was trying to build a new machine.

In the study of physical astronomy, we should not say we are satisfied, until we have comprehended a whole system of physical laws. To do this we must take a starting point, and from it go out to investigate and note down every physical principle in this great mechani-

cal structure. Many persons give up the task after only a partial investigation, others are satisfied when they can explain but one mechanical principle of this great system, while some are content with only a part of one of these great physical principles that go to make up this great machine of the heavens.

As there must be a "starting point" to the many years of study I have spent investigating the works of this great machine, I will take you back to about fifteen years ago and point out a few things I have been doing since that time. Then it was that Bob, Jim, Deck and I were school-boys together, and it was then we learned a reason for the rising of the ocean's tide on the side of the Earth opposite from the Sun and Moon. We learned a reason but we could not see any reason in it, and our instructor bothered and perplexed said, "If you can't believe what the book teaches you had better hunt out a better reason." From that date I have been on the hunt and the kind of game I have succeeded in bringing home appears on the pages of this book.

I don't know what Bob has been doing

since those school days but I have been informed he married young, and has had all he could do investigating the tides that ebb and flow about the hearth, where his wife and children congregate.

Jim, according to last accounts, had mounted the rostrum and was dealing in first-class oratory. He no doubt quit the study of the tides years ago.

Just what success Deck has had in producing a reason for the rising of the tide on the opposite side of the Earth, from its principal attracting luminaries, I cannot tell, but I have been told, that the bonds of matrimony and a sheep ranche down in Texas demand so much of his attention, that there is but little room in his mind for tide theories.

To modestly speak about my doings since my school days, I would say that, after some hard knocks in the rough world, I became a practicing lawyer, and on account of the scarcity of clients, or some other reason, I have found time to continue my study on the tides and other questions of physical science. One

reason I have continued my study on these subjects so long is because I seemed to be continually advancing and finding out something new. First, on starting out to discover the cause of the tides, I thought that if I could find out why the Earth rotates on its axis, I would then be able to tell why the tides appear as they do. For, thought I, the Earth is caused to rotate by some force from the outside, and where this force is applied, no doubt, is the place in the ocean's surface that is pressed in. At last, after some hard work, I was able to tell why the Earth rotates on its axis, but the tide question was still unsolved, and as to my axial motion theory, a scientist informed me that it could not stand unless I would give the natural law that moves our planet in its orbit about the Sun. This having been done, I satisfied him, but not myself. The tide problem was still unsolved. Thence I was led on, as we often are, by a desire to know more and tell our neighbors something new, and that desire prompted me to find out the cause of the general forms and motions of comets. Having satisfied my mind on that subject, 'twas

then with some hesitation, I began an essay on "Production and Destruction of Worlds."

It was not until the year 1879 that I was ready to give the reason for the Earth's axial motion, and 'twas during the next year I wrote my essay on the cause of the orbital motion of the Earth and Moon, and another on the general forms and motions of comets.

In the year 1881 I finished my essay on "Production and Destruction of Worlds," and early in the spring of 1882 completed one on "Philosophy of the Tides," and when this last essay was finished, I felt as though the work, I began years before, had been satisfactorily accomplished.

I might have discovered the natural laws that control the movement of the tides, as soon as I had finished my essay on the orbital motion of the Earth and Moon, but for some reason I did not grasp the extent and grandeur of those physical laws, and it was not until about two years had passed, that my eyes opened to behold the true philosophy of the tides and comprehend it, in the clear light of reason.

You will notice that after the essays contained in this work, come "Philosophical Chips," which are extracts from my recent lectures and debates, and are intended, in many instances, to strengthen and support the philosophical principles embodied in said essays.

In this work, I have failed or neglected to compromise or harmonize with the Bible, or any other religious book. I have had as much as I could do studying out a natural working system for these heavenly bodies, and expect every religious person to harmonize it with his religion as best he can.

I have tried, in all my productions on physical astronomy, to make everything so plain that a person with only a common school education can fully comprehend the philosophy I have used.

The reader is to be the judge of the merits of this work, and I want you, with the broadened and best view, to study and think for yourself. I have tried to bring before you scientific truths, and if I have erred, it has not been for want of labor and good intention.

I have endeavored in my labors to find out some philosophical truths heretofore unknown to us, and I am confident that, to the extent I have succeeded, I have been or will be rewarded.

Yours truly,

A. P. PICHEREAU.

GALESBURG, ILL., March 8, 1884.

OUR SOLAR SYSTEM.

NOTE.—For convenience, the Sun in the above chart is represented by one-fifteenth of its comparative size, and the orbits of the four outer planets by one-fourth of their relative distance from the orbit of Mars.

ESSAY I.

THE REASON WHY THE EARTH ROTATES ON ITS AXIS.

When we look about us to see the wondrous works of nature and observe the changes that hourly take place, we are often led from what we see to try and find out the reasons for all these changes and discover the laws that govern this world of motion.

We do not know, nor will we soon learn, all that might be known about this terrestrial and celestial world, though we are all the time extending our bounds in this branch of knowl. edge, yet there are hidden mysteries near at hand which have never been discovered. It has been the custom of late years among most nations to give every man due credit for making any new advancement in this line of thought,

and to accept a theory as true, if it appeared but reasonable. By this way of treating our fellows they have labored hard, and to-day physical science reaches over a broader domain than it ever has before.

We have heard it said, "wind is air in motion," and again and again we have heard it repeated, "there is no motion without a cause." What then is the cause of the wind's motion? The answer to this question is said to be, because the atmosphere in some climes becomes more heated than the adjoining atmosphere; it is thereby expanded, becomes lighter, and ascends, while colder denser air about it floats in to fill up the place made vacant by the warm air's departure.

The motion of a whirlwind and that of a cyclone was at one time a mystery, but now these motions as well as the causes which produce them, are clearly explained. Authorities say that a whirlwind, as well as a cyclone, is caused by two currents of air coming in contact with each other, and striking their outer surfaces together in such a way as to give their combined volume a whirling motion, which will

move on nearly in the same direction the stronger current was going when they collided. Besides being formed in this way, they are also formed by a current of air striking a resting or slowly moving body of air on its outer surface, in such a manner as to give it a whirling motion. Cyclones are usually formed high in the air, and are often accompanied by a rain storm whose very clouds are in this dreadful whirlpool, giving it strength and weight, while it leaps in its furious flights over the Earth, dealing out death and destruction.

I was told one time that it is natural for a body to take a whirling motion when it is passing through the air, and the fellow who gave me this valuable information, said: "A foot-ball turns, a base-ball turns, a cannon-ball turns, and all other balls turn as they pass through the air. Yes, the Earth and other planets turn while they are passing on through ethereal space."

These balls in the atmosphere or the planets in ethereal space, do not turn unless something turns them. It is not the nature of a ball to turn, unless it is turned by some force. A

foot-ball rotates by being kicked on one side of its centre, sending that side along the faster; it may also be made to rotate by being retarded on one side more than on the other, as when it strikes the ground. A base-ball rotates by being retarded on one side, as when it leaves the hand with a roll. A cannon-ball rotates because it is retarded on one side more than the other as it is shot out from the cannon; it may also be made to rotate by making it strike the ground, and thereby causing that side to be retarded the more, while the upper side moves on freely. No ball, either in the air or in ethereal space, rotates unless it is made to rotate by some force.

When we observe nature's laws causing a body to rotate, then it is as we meditate on this mighty Earth and its surroundings that we wish to know what makes it rotate on its axis.

It was in the spring of 1879 that I asked through the columns of a leading Chicago daily newspaper for some one to tell me, through that paper, "What makes the Earth rotate on its axis?" The scientist was mum; he did not reply, and the only answer I received—save a

few private letters—to my question, came from a Christian gentleman, a Mr. D—, of Kankakee, whose half-poetic effusion was published in that leading Chicago daily, and when summed up amounts to one of its verses, which reads as follows:

> "Like as our mothers turned the wheel
> And spun to clothe each coming heir,
> Our Heavenly Father for our weal
> Doth exercise his constant care."

Have you ever heard anything like that before? It is not news to me. I have often heard that answer. It was not what I wanted, therefore being disappointed I did not fully appreciate it.

When I asked for some one to tell me the cause of the Earth's axial motion I expected a scientific answer. I thought somebody would explain the natural laws by which this sphere is caused to rotate. Where and how a "Heavenly Father" takesapart in this rotary motion I can not tell. Nor do I intend while discussing this subject to try to harmonize science and the Bible. I only mean to give a scientific reason for the axial motion of our planet, and

let he who will tell how these scientific principles are connected with a "Heavenly Father."

The question which I now propose to answer is a common one; it is a question asked and thought of by each and every one of us. When we were children, as quick as we were told by our instructor that the Earth rotated on its axis every day, our query would at once be, "What makes it turn on its axis?"

Though our fathers and grand-fathers and great grand-fathers may have asked this question, and given their opinions over and over again, yet we need not go many generations back; it is not necessary for us to look over the records of the past for more than six hundred years back, to find the time when this common question was not known to the civilized world. This question was not known because there was no use for such a question; first, it was necessary that men should believe the Earth turned on its axis, before it was required of any one to answer—why does it turn?

The ancients, the very race from which we have descended, believed the Earth to be one vast plain, crossed by mountain ranges, drained

by rivers, dotted over here and there by lakes, and fitted for the abode of man; that around this vast plain, this dwelling place of man, there was a great ocean of water, and that beyond this ocean of water, at its very edge, if edge it had, there was the stepping off place, the unknown brink, where it was thought man could look above and below into boundless space and there behold the realms of saved and lost souls.

Our worthy ancestors had some curious notions. It was impossible for them to understand how the Earth could be in existence unless it rested on some object as a support; they, therefore, had various notions as to what this support was. Some thought it rested on the back of a huge tortoise, while others thought a giant man supported it on his shoulders. They named this strong man "Atlas," and he to this day is pictured in giant form with this sphere upon his back, bending beneath his ponderous load.

By and by an astronomer and philosopher by the name of Ptolemy appeared to awaken the people with new and progressive ideas. His teachings were not all true, but they with their

faults were far in advance of the doctrines taught before his time. Ptolemy believed and taught that the Earth was the centre of the universe; that it stood still, it rested on nothing, while the Sun, Moon and stars revolved around it every day.

There also lived about this age of the world a remarkable philosopher, who taught nearly the same astronomy that Ptolemy proclaimed. This man of lasting fame was Plato, but Plato differed in some respects from Ptolemy, for Plato in fixing the position of the Sun, Moon and stars, placed them in others relation to each other; than they were placed according to the Ptolemaic system. Without commenting on or fully explaining these men's views, I will proceed to consider the teachings of a remarkable astronomer, a man, who though he lived five centuries ago, to-day his thoughts are in the mind of every school child. The solar system, as he mapped it, was as you and I map it. Though this truly great man may have derived some of his thoughts from others, yet to Copernicus we give the honor of founding the Copernican System. It has been claimed

by the Greeks that their citizens Pythagoras, a worthy philosopher, had arrived at the truth of this system long before Copernicus existed, but whether this Grecian claim is true or false, it matters not to us. We know that Copernicus has justly earned the credit, for he did not only think it out but talked it. He wrote about it, and sent it down to posterity as the work of his brain. Copernicus believed, and his writings teach, that the Sun is the center of the universe or solar system, and around it the planets pass, each in its separate orbit.

> From age to age these grand old orbs have run
> Unnumbered times their circuits round the Sun,
> When living man from old friend Earth has gone.
> Existing forces will these worlds move on.
> About one side is ever breaking day,
> And on another evening whiles away;
> From west to east these great spheres onward roll,
> And plow the ether while they seek their goal.

Copernicus was born in Poland and the remnant of that ruined nation may be proud of him for his name will ring with an immortal echo away down the long line of our posterity for ages on ages to come.

About this time there lived other noted men

who were valuable philosophers and astronomers. There was Tycho Brahe, who, though he was a disbeliever in the Copernican system, was a wise, earnest man; and there was the great observer, Kepler, who, in advance of Newton, fixed the orbits of the planets and measured the heavens. We must not forget to mention the great discoverer, Christopher Columbus, a man who dared to venture out on the broad Atlantic, against the prayers of his friends and the pleadings of his relatives. He went forth because he was confident he would find land by sailing westward; if not the new continent, he believed he would come to the eastern shore of the old. He ventured on his own opinion, and his voyage resulted in the discovery of America. He opened the way for our forefathers, who unloosed the shackles that bound them to tyrant thrones, and prepared a glorious free home in this new country for themselves and their posterity.

I will now speak of a man who lived about this time, who, under the worst disadvantages, rose to be the greatest astronomer of his time. This man, of the few greatest astronomers of

the world, was Galileo, the inventor of the telescope; the man who, while in Rome, did not do as the Romans did. He disbelieved in the Ptolemaic system, which for fourteen hundred years the Romans had adopted as the true one, and was fully set forth and explained in a book which has been called the Astronomical Bible. Among the Romans, when Galileo was there, it was against their laws to introduce any new astronomical theory contrary to their Ptolemaic Astronomical Bible, and he who did so was liable to be published as an infidel and a criminal. But what cared the immortal Galileo for their laws. He was armed too strong in honesty to be easily frightened and driven from his convictions. So, when he was arrested and brought before a body of grave inquisitors, and told that he must promise to quit teaching his doctrine or suffer the punishment of death, the great, wise old man decided to live; but it is said that when he arose to depart, he stamped with his foot the Earth, and said, "It does move."

It was not until the sixteenth century that the majority of the civilized world were willing

to accept the Copernican system as the true one. It was not until about this time that mankind generally believed the Earth revolves around the Sun and rotates on its axis.

In that century there lived a man whose fame has reached every clime and his name should be ever honored for his worth. From seeing an apple fall from a tree one day, he proceeded to establish the laws of gravitation. From attraction of gravitation on the Earth's surface, he extended his laws to the farthest planet of our system then known. He also made some very valuable discoveries in light. This worthy man of whom I am now speaking was no less a person than Sir Isaac Newton. This astronomer and philosopher answered many questions that had never been answered before, and at last he attempted to give a reason why the Earth rotates on its axis every day. Mr. Newton said: "This motion is probably caused by centripetal and centrifugal forces," but he never gave us any reason why these forces should turn the Earth on its axis in the way it now rotates.

There has been a scientific speculator of

late date who tries, by a mathematical process, to account for the axial motion of planets from the supposition that they are gradually cooling, and contraction makes them rotate. Those who study for the truth will soon see the absurdity of such a theory.

The planets of the solar system have a very rapid motion in their orbital course around the Sun. Our Earth travels in its orbit about 570,000,000 miles in a year, during which time it performs one revolution about the Sun. At that rate of travel per year it would go 68,000 miles an hour. Its axial motion at the equator causes its surface to move about 1,000 miles an hour, so it is plain for us to understand that we are being carried on by two motions, one bearing us onward around the Sun at the rate of 68,000 miles an hour, while the other carries us around the center of the Earth at the rate of 1,000 miles an hour. What force keeps up the orbital motion of the planets, I will not now explain. It is my object here to show some natural cause for the rotation of the Earth on its axis as it passes in its orbit about the Sun through that ocean of ether that fills its path.

When I speak of that ocean of ether that fills its path, I mean that fine fluid that fills all space unoccupied by something more dense. There are men who deny the existence of ether in space; but when you find such men in this enlightened age, you find in them poor authority. The astronomer and philosopher, Dick, a man of much learning, and other noted astronomers who lived at and before his time, believed that interstellar space is filled with ether, and that a body, in passing through this ether met with a resistance. The undulatory theory of light proves conclusively that there is an ether in space. This theory of light is the one taught and believed to be the true one by professors and scholars in all our colleges and schools. That light moves or is transmitted by waves through atmosphere and ether, is a positive fact which experiments repeatedly made prove. There are other reasons which prove the existence of a resisting ethereal medium in interstellar space, and when all the evidence is brought together, the proof is so strong that you and I have no reason to deny it.

The question now arises, What is the dens-

ity of this ether? It may not be 1-10,000 as dense as our atmosphere; but, believing this ether to be a substance, though a very rare one, me must then believe that a body thousands of miles in diameter, when forced through this ocean of ether at the rate of 68,000 miles an hour, will meet with a resistance. This resistance may not be more than 10 pounds while the body moves one foot, and it may be 10,000 pounds for every foot it advances. Be it much or a little, it is something. This fact is an important item in producing the axial motion of the Earth, and I wish you to remember it.

From that boundless ethereal world let me lead your mind to the atmosphere of the Earth and other planets, and there find what common sense teaches and authors know about the oceans of air that envelop this, as well as other spheres. I remember well the time when my mind first began to take hold of Nature's scenes and Nature's laws. There was a time when I thought the air I breathed extended everywhere above me. It had no limits. It was unbounded and unbindable. But since those boyhood days my understanding has changed very much, and

now I believe I can view the universe, as a full-grown man should see it.

The atmosphere of the Earth has a limit; it has bounds; but just where these bounds are, seems to be a question of dispute. It has been said by some authorities that the atmosphere of the Earth, has been proven by measurement to be fifty miles deep, and often these same authors say, "The meteors that float in space and come in contact with the Earth's atmoshere, never blaze or become ignited, so that we dwellers on the Earth can see them, until they come within the limits of our atmosphere. The cause for their being ignited is on account of the friction they receive as they pass swiftly through the atmosphere, making them sometimes be at a melting heat, and often causing them to explode. The height of these blazing meteors are sometimes thousands of miles above the surface of the Earth."

It is said that the meteoric shower that occurred at Niagara Falls in the year 1833 was one of the finest ever witnessed; that each glowing ball seemed to descend from a height of at least 2,200 miles. Having been anxious to find

out the exact height of our atmosphere, I have searched through a great many authorities to arrive at a satisfactory conclusion. While I was one day looking through a library of scientific works not long since, I took from the case "Humboldt's Cosmos" and there read what that author had to say on the subject. Alexander Von Humboldt was a man of marked ability, a philosopher of merit, and a benefactor of this nineteenth progressive century. This man of much worth says: If the Earth's atmosphere gradually decreased in density as its distance from the surface of the Earth increases, at the height of fifty miles, it would become nothing; but as it is of course very dense at the surface of the Earth, owing to its moisture and earthy composition, it is absolutely certain that it does not gradually become rarer as the distance from the Earth's surface increases. From which reasoning we may believe that at an elevation of one hundred miles it may not be much more dense than it is at an elevation of one thousand miles. Humboldt says it is impossible to arrive at exactly the depth of our atmosphere, and concludes his opinion on this subject by saying

the Earth's atmosphere may be thousands of miles deep. More modern authors seem to think about as Humboldt did and confirm what he said on the subject.

From the numerous observations on the planet Mars all seem to confirm an established recorded opinion of old astronomers, which opinion was, that the atmosphere of that planet is very dense, and also very deep. It has been observed that when the planet Mars is about to pass between the Earth and a star, before the main body of this familiar planet reaches the star, it is dimmed by the atmosphere of Mars for some time. From these observations the atmosphere of Mars has been estimated to be several thousand miles deep. If Mars has an atmosphere of this depth, why should not the Earth have one similar to it? The planets Earth and Mars appear to be alike in so many other respects, why should they not have similar atmospheres? The Earth's axis inclines from a perpendicular about twenty-three degrees; Mars' axis inclines from a perpendicular about thirty degrees. The Earth turns on its axis in about twenty-four hours; the planet

Mars turns on its axis in about twenty-four hours. Mars appears to have clouds floating over its solid surface; seas, continents, mountains and volcanoes are observed on its disk. If the planets Earth and Mars are alike in so many other respects, why should they not have like atmopheres?

From what I can gather by study and authorities, I have concluded that the Earth's atmosphere, above the equator, is several thousand miles deep. This atmosphere, or ethereal air, may be very thin at that high altitude; but it is reasonable for me to believe that this gaseous compound that envelopes our globe and passes with it in its course about the Sun, at the equator, is several thousand miles deep. I also believe the great depth of this atmosphere affords a protection to all things living on this globe; that if the atmosphere was but one mile high, ethereal resistance might sweep the forward part of our globe bare of atmosphere. It must be deep. I believe that in order to bring into existence and keep in existence the animal tenants of this globe, it is necessary to clothe this sphere with a deep, soft covering,

so that it may be tumbled on with "the flight of a star" without disturbing us.

Our next object will be to see what effect the heat of the Sun has on our globe deeply lined with its vast atmosphere. We all know—or ought to know—that heat will expand atmosphere. When I was about twelve years of age, I proved this fact by experiment. I took a bottle, corked it up tightly, then placed it in some hot water on the back end of our kitchen stove, and with anxious eyes and ears, awaited the result. By and by away flew cork and hot water in my face with a loud report. This called some of the family to see what had exploded. I told them what had happened, and concluded my say by remarking, "Well, heat does expand air." When we consider that the Earth's atmosphere is several thousand miles deep, and that directly under the Sun that atmosphere, pierced by his warm reflected rays, is greatly heated, it is then not difficult to believe that the atmosphere of our globe which is exposed to the Sun's rays is greatly expanded. Another source of expansion, during the day time, is caused by the action of the heat from

the Sun on the waters of the hemisphere which faces it. A great portion of these waters are evaporated, and ascend into the atmosphere in the form of clouds. Solids are also expanded by heat, and after a long investigation I have concluded that the atmosphere of our globe, directly under the Sun at the equator, is several hundred miles deeper than it is at midnight on the opposite side of our sphere.

I have argued, while discussing this subject with friends, that if the Earth performed but one revolution on its axis in six months, that the atmosphere on its surface would—on that side which faced the Sun for so long a time—become thousands of miles deeper, than it would be on the opposite side of our globe; and also, if the Earth should stop its rotating on its axis, and one side of it from this time forth and forever face the Sun, that then all the atmosphere on our globe would tend to seek that heated side, and when the cold air on its surface, which had come from the opposite side of our sphere, became heated and expanded, it would rise, and by ascending, make room for its crowding companions which had floated

after it from the same far-off clime. Now, if this natural law kept up its work, it appears to me that it would not be long before that dark, cold, lifeless hemisphere of our globe would be almost destitute of any atmosphere. But such an experiment will never be tried, such a state of nature will never exist, while the Earth, the atmosphere, the ethereal space and all the natural conditions of the universe remain the same as they are to-day.

Having thus far set forth the physical condition of the Earth and its surroundings as I understand them, first, the earth passing rapidly through ethereal space, and secondly, showing how it is enveloped by a deep atmosphere which is continually expanded as it is exposed to the Sun and contracted when it is absent from that luminary, it is now my purpose to show by illustration that when a person believes the physical conditions in nature are as I have expressed them, they then can easily understand why the Earth has a rotary motion in the same direction it now is turning.

To hastily explain, I would have you tie a feather to a buck shot, then throw them into

the air and observe which will go in advance of the other—the heavier and denser body or the lighter and bulkier one; a loaded arrow with a feather at the other end will illustrate the same law. I have tried a great many of these common experiments, and have always found the law of nature to be that, if one side of a body is lighter and more bulky than the opposite side, when this body is swiftly passed through a resisting medium, the lighter and more bulky side will always go to the rear, while the heavier and more dense side will go to the front.

A fellow once asked me if attraction of gravitation did not aid with its power in some way to help turn a planet on its axis. I believe it does, and my reason for believing so is because of its general laws. I have noticed that a body here on the Earth's surface, which is more densely loaded on one side, than on the other, when thrown out on the commons, ere long will have that densely loaded side turned towards the center of the Earth, its center of gravity.

I remember when I was a school-boy of a little sport we fellows used to have. When the

teacher was not watching us—which I have often regretted was very seldom—we would take a piece of the lightest pith, shape it in the form of a jug, load the bottom with shot, carve its top as near as possible in the shape of a monk's head, and then call this lubberly fellow "the upright monk." Whatever position we would place this fellow in,—on his head, side, back, or face—he would always spring to his feet, and do it quickly. That pith monk I now turn into a practical purpose to illustrate the position a body seeks when one side is heavier than the other, all caused by attraction of gravitation which attracts the denser and heavier side the more.

Now let us change our center of gravity from the center of the Earth, to the center of the Sun, and have the Earth to play the part of "the upright monk." It is reasonable for us to believe it should act its part like the monk, and the proof is, that, as soon as the hemisphere of the Earth which is facing the Sun has had its atmosphere made lighter by expansion a sufficient amount, the opposite hemisphere of our globe, whose atmosphere has become con-

tracted by the absence of the Sun, will—according to the rules of attraction I have just mentioned—be drawn toward the Sun and proceed to get nearer by taking the place of the expanded hemisphere, and so begin and continue to rotate on its axis.

This law of attraction has nothing to do with starting the Earth, as well as other planets, to turn in the direction they now rotate. Planets were first caused to rotate from west to east by their receiving more resistance in proportion to their weight on their expanded sides that face the Sun than they did on their contracted sides, which were absent from the Sun's rays as they were hurled through the medium in space. If a planet receives more resistance in proportion to its weight, on one side than it does on the other, though this difference be but one pound for every foot it advances, I believe that side so resisted would be retarded and go to the rear, while the opposite side would move forward, and thus begin to rotate, and as long as the same natural laws existed continue its rotation.

Which of these laws has the more to do in

causing the Earth to rotate on its axis,—the attractive force for the heavier side, or the resistance of the medium in space on the light and bulky side? I cannot exactly tell. I believe the latter force would make our Earth rotate as it does, and I also believe the attractive force alone after our Earth had been once started to rotate as it now does, would continue its motion in its present constant and regular way.

ESSAY II.

THE REASON WHY THE EARTH REVOLVES AROUND THE SUN, AND WHY THE MOON REVOLVES AROUND THE EARTH.

When a person writes a letter or makes a speech, he should know the character of the person or persons he is addressing. I have met men during my short travel on the broad highway of life, who appeared to be contrary in everything; who, when you would talk sense, would prefer to talk nonsense, and when you would do your best to be agreeable they would be extremely disagreeable. I have no patience with such fellows, and if I had my way about it, they would all be manacled, and locked up securely with that class of persons whom Shakespeare vented his wrath upon, because they had no music in their souls. They should

all be put into the same boat, and not a man of them be trusted.

If I were addressing a friend, or an old schoolmate, who in past days of hope and pleasure, played bull-pen or leap-frog with me, I would, if such were the case, take much comfort in the work now before me, and expect my effort to meet with his approbation. When you deal with such old companions, you can generally tell what to expect, but in the case before me, as I set out to produce an argument in physical science and produce a theory of my own labor, I will in this effort speak to both friend and stranger, to men of all religious persuasions, to the infidel and quasi-infidel, to the minister, professor, doctor, lawyer, merchant, tradesman, laborer, and others of other vocations, they all may note and all accept what may appear to be the truth, or denounce and condemn both this argument and its author.

We must venture some when we adopt a new theory, for there is the new plan, the untried foundation and the suspicious machine. A cry comes from our friends, "Take care! keep back! stop! you may rue the

advance you are wanting to take!" We hesitate, then with a firm resolution, we make a bold spring and alight, fearless of any danger, on this newly-discovered structure. When we are once there we look about, and finding all around radiant with truth, and gorgeously grand, we wave our hats and beckon our friends to come and take a place beside us. By and by an old companion of ours comes out. He believes our position safe and he is willing to trust his own judgment, and before long we find him at our side. Soon others come, and very soon we find ourselves surrounded by a crowd of brave, hearty fellows who are firm believers in the strength of the position they occupy. Then come strangers; people of a foreign clime press their way to the front, till, all of a sudden, we discover representatives from every part of the Earth are with us. And now when our theory is about to reach the crowning point of its popularity, we should cool our ardor by solemnly reflecting and asking ourselves these questions: Will it ever cease to live? Will it prove to be an error, and it as well as its author and supporters cursed, condemned and ridiculed?

If a theory is untrue, it would be best for the world if it should die in its infancy and not live to lead the human race into an error; but if a theory is true, there should be a general welcome to it everywhere as it makes its advance about the world, carrying its truth all around this globe, and dealing out knowledge and light where there was ignorance and darkness. So, in choosing the good from the bad, in selecting truth from error, we cannot be too cautious, and men should not be blamed, when they hesitate and seem to be afraid to accept a new idea or a theory, which touches the spring and opens the window, from which appears in mighty motion some machinery of the solar system.

There has been for some time past an idea, a theory, in my mind, which seems to explain why the Earth has an orbital motion, and why the moon revolves in its orbit about its center of attraction. I have been cautious about publishing my theory in regard to these orbital motions. My approach to this present step has been gradual, and at every moment since the day I stood alone with this theory, I have been

reinforced; volunteers have enlisted to defend this cause, and now, with the hope of one who has been victorious in several battles, with some friends come out boldly to fight all opposers who wish to engage in this mental contest.

I dislike very much—while producing an argument on the orbital motion of planets—to come in contact with some worthy old philosopher's theory. I hesitate in this instance, before I attack an old author's theory on the orbital motion of planets. Why I should dislike the task or hesitate to make the attack, I cannot tell. I believe in a person advocating what he considers true, and blotting out all error, therefore I proceed.

That a certain old author erred when he said "the planets move in their orbits because and only because they were started to move," in my mind seems certain. "A body when once started to move, if acted upon by no other force than that which starts it, will move on in a straight line forever; if it is acted upon by an attractive force, it will tend to be drawn to that attraction, and its motion will be in a curve, a circle, or an ellipse about its center of

gravity." I believe in that statement, as I have just quoted it from an astronomical work I have before me, but when these old authors take the next step, and say the *planets' orbital motions* are in accord with this major premise, "it is a parallel case," then is when we should become doubtful of the truth of their theory, and by investigating the physical construction of the universe, become prepared to declare the logic of these old veterans unsound.

These authors say: "The Earth was started with two motions, one about the Sun and the other about its own axis; there was nothing in the universe to retard these motions, so they have kept up the same routine of action for these hundreds of centuries.

"The Earth would move on and on, in a straight line, if it was not acted upon by the attraction of gravitation of the Sun. This attraction of the Sun tends to, and does cause it to move about that luminary in an elliptical orbit." Let me ask you if the planet Earth has not some opposition which would check and finally stop these motions if they were not continually revived by some force in nature?

Would not the ethereal fluid in space check the orbital motion of the Earth, as the air will a ball you throw to reach a distant point? And also will not the Earth's axial motion be retarded as it turns in this ocean of ether, as a ball will gradually cease to rotate when it is whirled into air or water? There is another reason why these old authorities seem to be mistaken, for as we understand the laws of attraction of gravitation between the Earth and the Sun, that half of our Earth that is facing the Sun at this moment is more attracted by it than that half of our sphere which is now the greater distance from that fiery mass; the part of the Earth nearest the Sun is held the strongest by that great central attracting luminary. If such is the case it would require renewed force applied to this sphere or else on account of its being all the time attracted on one side, its axial motion before long would entirely cease, and one side of our planet be as constant in facing the Sun as our Moon is in facing the Earth.

Why should not the Moon's motion in its orbit die out? What reason is there to hinder it from ceasing its orbital revolution if it never

received but one pull, push or throw into space? By the attraction of the Sun it is all the time influenced to get and keep between the Earth and Sun. If it is continually drawn toward this position why should not this strong attractive force in a short time overcome that first and only, and, as some say, everlasting force? There is a living, acting force that runs the mighty machinery of this great universe. It is contrary to logic that the motions of the spheres came, and have continued, by an unrenewed or unaided force that first sent them out into ethereal space. It is against the laws of nature and all her works, that any motion should exist and continue without being renewed and kept going by some living force. You may think, reflect and search in vain for a true example of such a motion. The only example given of a "blind force" in nature is where some authors tell us that "the planets, satellites, asteroids and comets move because long years age they were started to move so."

When Borrelli, Newton and other believers in the non-destructable throw or push centrifugal force, or a centrifugal force they failed to

explain, said—"the planets are kept in their orbits by centripetal and centrifugal force"—they spoke the truth, though they did believe in a "projectile" or "falling body" centrifugal force, that never runs down.

Sir Isaac Newton taught, and his followers teach, that this centrifugal force *is independent* of the Sun about which these planets revolve, and they could just as well go around that great orb in one direction as another. This—as you have discovered—is not the kind of centrifugal force that I believe in. I believe that this "centrifugal force" *is dependent*; and that it depends upon, and results from, the force that constantly moves a planet in its orbit, which force swings out, and on the orbital moving sphere about a rotating sphere, its center of gravity.

Have you ever tried to discover any thing in nature that would continually act upon the Earth or Moon to urge them on in their orbital course? If you have not then stop for a moment and see if you cannot think out some force in the universe, as we understand its physical laws, that will continually act on either of these planets, and cause them to move

on in their orbits. I was led into the theory I shall soon attempt to explain by having been asked the question over and over again, until I believed it could be answered. The question at last became so common that I felt ashamed of myself and my predecessors. I searched for an answer in such astronomical works as Newton, Kepler, Dick and others published, but found in them no reasonable answer. I had attempted several times to give a reason why the Earth has an axial motion, and I was thought by some sober-minded fellows to have given the true answer, and one that cannot be disposed of without banishing a truth, and now these same earnest fellows have asked me again and again to tell them why the Earth moves in its orbit about the Sun, and why the Moon has an orbital course about the Earth. Well, sirs, you must stand by me, and if some astronomer arises in his glory with his hosts of veteran warriors to give us battle, I don't want to see you skulk away like cowards and excuse yourselves by saying, "I am not armed." If truth is on our side, and we battle to conquer, ours is and will be the victory. If I had not

believed firmly in the theory I am here to explain, I would never have dipped my pen to write one sentence on the subject.

I have often looked at the Moon, that glowing messenger of night, and said, while I viewed the heavenly dome: "How grand are the works of this created universe!" There seems to be the burning Moon sweeping on through the heavens from east to west, but here I stop, reflect for a moment, and then say: "No, no; it don't travel in that way; its apparent motion in that direction is caused by the Earth turning on its axis from west to east."

Now, as we are observing that night luminary's orbital course, I think of the force that carries it around, and say to my companion who stands by, Is it not remarkable that attraction of gravitation should be the principal means of all that glorious motion? Yonder floats the Moon; there Venus appears in her soft light, moving on; here beneath us is the Earth, which, to those far-off planets, must be a mysterious orb.

The Earth carries us about its axis at the rate of about 800 miles an hour, and at the

same time we are borne on in the Earth's orbital path at the rapid rate of 68,000 miles an hour. If you could leap up from the ground to the height of fifty miles, you would come down nearly in the same place you are now standing. If you could in some way elevate yourself above the Earth's atmosphere and remain there away off in that ethereal space for about two days, and then come down to the place from where you started, what story could you tell of your travels? Would there not be something in your experience of interest to all with whom you conversed? You would tell us that you ascended to a great height; that you expected all the time the planet Earth would leave you; that, as the Earth was going on in its orbital course at a furious rate, you had no power in yourself to keep up with this planet's flight, and often you would anticipate your fate and become faint with fright; but at times when hope seemed to be all gone and despair was your only companion, you would look out about to view the surroundings, and there, at the same distance from you, would be this splendid globe, and you would think as you

viewed the scenes about "thou art my mother Earth, thou art my protector." You would also tell us about the day and night you passed through while up there. You would say: "I was up there about forty-eight hours, and while I was up there, it was night for about nine hours, and day more than four times as long. When it was night I was in the shadow of the Earth, and when the day prevailed, I was out of this shadow. From what I can understand, I must have been carried about the axis of the Earth by some force, though from my observation the surface of the Earth seemed to be slowly passing beneath me; but, as I went up there while it was day, and while up there the Earth passed between me and the Sun, it must be that I took up some kind of an orbital motion, and made a revolution in that orbit in about forty-eight hours."

This would be a wonderful experience, but if you could elevate yourself away off there in that position, and keep yourself up at that height from the Earth's surface, you would experience just such a time.

If it were possible to elevate a mass of

matter one hundred thousand miles above the surface of the Earth, and the Earth's power of attracting and repelling were equal on that mass of matter, so that it would not be driven from or attracted to the Earth, and this state of nature existed continually, that mass of matter, so situated, would become and continue to be a satellite of the Earth, and revolve in its orbit about our globe in about ten days. If an object on being elevated three miles or fifty miles above the surface of the Earth, is carried on by the axial motion of this planet, why should not an object or a satellite which is placed one thousand, ten thousand, one hundred thousand, or two hundred and forty thousand miles, be carried on in the same direction? It is a fact that the farther away you place the satellite of the Earth, the slower it will move in its orbit; if the Moon's distance from the Earth was only one hundred thousand miles, it would perform its revolution about this planet in less than ten days.

Why should masses of matter, when placed off from the surface of the Earth, go around our globe? Why do not these objects, when

placed out of the influence of our atmosphere, stand still, or if attracted by the Earth, get behind this sphere, and in this position travel on through ethereal space? Why should these bodies take up an orbital motion?

There is a reason for the orbital motion of the Earth and Moon or any mass of matter about an attracting rotating sphere. To illustrate my theory in rather an imperfect way, I have arranged a circle of magnets in the following manner. On a wooden wheel place a circle of magnets so that their ends, which have the greatest attractive power are just over the outer edge of said wheel, have said wheel placed on a perpendicular axle, so that it can be easily turned on said axle, then encircle said wheel, with two wire hoops, which are to serve as rails or guides, on, and almost between, said hoops, place an iron ball, that will roll on these hoops by a very slight force being exerted upon it. When the wheel that supports the attracting magnets is stationary the ball will be at rest, but when the wheel is turned the ball will take up a motion in the same direction the wheel is turning, and as long as the wheel con-

tinues to turn the ball will keep on going around. To cause the ball to have a rapid motion in its orbit, it must be placed near its rotating attraction.

I do not propose while attempting to explain a theory in physical astronomy, for the perusal of the child, as well as the adult, to give any long mathematical demonstration to prove the truth of this theory; its truth is plain and self-evident. According to the laws of mechanics this theory can be proven to be true. The orbital course of these planets give evidence of its truth, and mathematical demonstrations, based upon laws which were established by the immórtal Newton, proclaim this law to be real, actual and existing.

Suppose that the Earth was divided into two equal parts, and that each of these parts became a sphere and adjoined each other in close proximity, and that these spheres so divided rotated on an axis which was between them, then and in that case the center of the sphere nearer the Moon would be about 4,000 miles nearer that satellite than the center of that sphere farther from that secondary planet.

If such a state of nature existed and these spheres rotated on an axis, as I have described, then the sphere nearer the Moon would influence that body in the direction it was going, although the opposite sphere would be moving the contrary direction, with the same velocity, yet it would not have as great an influence on the Moon on account of its being 4,000 miles farther off from that satellite.

The law of attraction of gravitation as laid down by an old author, which is that "gravity varies inversely as the square of the distance from the center increases" probably holds good in all cases, and no doubt will prove true when applied to the spheres I have been describing. According to this old established law, the theory which I have been supporting can be clearly set forth by a mathematical demonstration. To find the force that moves the Moon about the Earth, it is first required of you to find the difference of attraction of the nearer and farther hemisphere of the Earth on that satellite; by finding this difference, you find the attracting force in the hemisphere of the Earth that moves the Moon in its orbit. It is the attrac-

tion of the Earth in that part nearest to the satellite that causes it to take up an orbital motion, as the side of our sphere, that faces this satellite moves away or around it draws the satellite after it continually. The further off an object or a satellite is from the Earth, the less it will be attracted, and consequently the slower it will move in its orbit. I believe the rule for the times of the revolution of a planet, satellite or object is about as Newton and Kepler give it. If this attractive force will cause or assist in causing a balloon to go around its center of attraction, the center of the Earth, and will cause an object ten thousand miles high to go around this mass of attraction, and will also cause the Moon to revolve in its orbit. What else will it do? This same attractive force when it is acting in the Sun, the center of our solar system, that great center of gravity, as it turns on its axis every twenty-five days, will cause its whole system of planets to revolve in their orbits. Mercury, that swiftly flying messenger being nearest that great center of attraction, speeds on its way the swiftest of them all. Away off, after a long search, you may see

a little spark in the heavens called Neptune, the most distant planet from the Sun of them all, and the slowest moving planet of the system. It appears as the Sun moves its surface around, each one of the planets are drawn after that moving surface, still continuing in their effort as they are attracted by the nearer attraction of the Sun to face the same side, they fail to keep up with that luminary's axial motion, and are observed to lag behind. If the planet Mercury was only distant from the Sun a few million miles, it would then perform its orbital revolution in about the same time the Sun rotates on its axis.

Just here you may ask, for here is the place for the question, What makes the Sun rotate on its axis? I will try and answer that question as well as it can be answered. My answer does not give any certain reason. It has been ascertained, by the observations of astronomers that the Sun moves in an orbit about some common center. From what I have learned about this luminary's physical appearance and its positions, I believe it does have an orbital motion. As we know but little about

its relation to other Suns, it is impossible to give any certain reason for its orbital motion, but we no doubt are safe in saying gravitation, electricity, and change in temperature, influence that great sphere in its orbital course.

Now as I am convinced, and the proof shows, that the Sun has an orbital motion, I therefore conclude that about the same laws govern its axial motion that control that motion in the planets. The axial motion of the planets I have discussed at length elsewhere, and I find no room for an explanation of those laws here.

It may be just, while continuing this subjeet, to speak of the orbital motion of the inner satellite of the planet Mars. This satellite performs its orbital revolution in less time, than that planet rotates on its axis. If a satellite of Mars does really have this rapid motion, it can be accounted for, and accords with the laws of motion embodied in the theory I have been attempting to explain. There can be an orbital course pursued by a planet or a satellite under certain conditions, in which it will have a ten-

dency to move faster than the attraction that sends it on; but such a motion is an exception to the general rule. Until this inner satellite of Mars was discovered by Hall in 1877, all authorities on the motion of planets and their satellites laid it down as a universal law that the principal rotated on its axis in less time than its planet or satellite performed a revolution in its orbit.

There are some other satellites which have very strange motions. These remarkable ones are those of Uranus and Neptune. These planets as well as their satellites are set away off so far in the heavens that it is difficult for the observer to tell much about them. But satellites have been discovered revolving around these planets in very peculiar orbits. It is and always has been very difficult to trace these satellites in their orbits, but from all observations thus far taken the orbital motion of the satellites of these planets, as well as the axial motion of the planets themselves, does not exactly agree in all respects with the general motions of the planets or conform very well to the laws that

govern these general motions. I have spoken of the axial motion of Uranus and Neptune as if some astronomer had discovered from observation that these planets have an axial motion. If these planets are in the same state of growth as the Earth, I believe they have an axial motion, not because it has been recorded so by some observer, but because the orbital motion of a planet or satellite is generally wholly caused from or results from such a principal's axial motion. The axial motion of these planets, I believe when discovered by observation will be found to be in nearly the same plane as the orbits of their satellites.

It is not only satellites and great planets that are swayed by this natural law, but that unnumbered host of asteroids, which traverse inter-planetary space in their certain and rapid way, are carried on in their circuits, by their principal's axial motion.

What I have said in discussing this subject has been with an honest purpose, and with due respect to the professional scientist, either the dead or the living. I trust the reader will re-

gard the author of this production as a person "subject to err," but who with the most modern scientific facts and theories has labored for the truth and done his best to clearly comprehend and explain a great law of physical science.

ESSAY III.

COMETS—THEIR GENERAL FORMS AND MOTIONS—WHY THEY ARE AS THEY ARE.

In the year 1858, when I was a little chunk of a boy, not big enough to do much work, but just large enough to follow close on the heels of my brother and learn the art of farming by following him about our farm, as he proceeded to do his work, which was weeding the garden, carrying water to the field, milking the cows, churning, catching young chickens to fry for the town folks who made us frequent visits, and taking part in a great many other privileges that farmer boys are especially favored with, all of which I cannot here mention; it was between these little exercises and when our family were about to retire for their night's rest that we would all go from the house into

the yard to see the great comet that hung away off in the heavens, and seemed to be hurrying away to an unknown destiny. All us observers had something to say about this fleet messenger, and among the rest spoke "Old Mrs. Boys," an elderly lady, who in those days traveled about the country in certain neighborhoods, piercing quilts, making straw hats, and doing her best in every way to make herself useful. She had a remarkabte physique, very tall, thin in flesh, big feet and hands, and as homely a face as I ever saw, and with all this appearance when she got a clay pipe to her mouth and began to puff the incense of the tobacco weed, she would then present quite an aspect; she had a remarkable look, why shouldn't she have? Well, "Old Mrs. Boys" then had her talk. She told us the appearance of a comet was a warning of great trouble, something awful was to come over our country; we were a-going to have war! Didn't she strike it? For in about four years she happened to be at our house again, and this wonderful prophetess remarked to each one separately and jointly: "Didn't I tell you so? I knewed so." Yes, she "knewed so," poor old

lady, she is in her grave now, no doubt, and has carried her knowledge or foreknowledge with her.

It is strange that until this day, when I hear a person say a comet is the herald of war, I see the visage of "Old Mrs. Boys" before me, and hear her repeat, as I have heard her repeat before: "Didn't I tell you so? I knewed so."

There are persons, no doubt, and many persons, who believe as "Old Mrs. Boys" believed, but we don't often meet them. There are people who are so situated that they can not or will not acquire any education. All persons who can read should know that comets are governed in their movements by physical laws which, when fixed, so bind the wanderer that his opportunity for breaking away from these fast-holding physical principles, for the purpose of visiting a certain republic or kingdom on the Earth is extremely bad.

From remote times, astronomers have spent much time trying to investigate the composition of comets, and the result of different men's efforts are not exactly alike in some minor respects, but in general they are the same.

They conclude that these mysterious travelers of ethereal space are composed of a very light substance or fluid. It may differ, perhaps, from any gas or composition of gases on our globe. There have been but occasionally some seen which indicate any of their parts to be composed of solid matter. The most dense or the solidest part of a comet seems to be in the nucleus. This apparent center of many of the comets which have been particularly observed, seems to be in such a mass, that the general opinion from all observations is that they are either solid bodies of matter, particles of matter not yet consolidated, or very moist air or vapor, or else a composition of dense gases.

The head of a comet comprises the necleus and coma; the coma surrounds the nucleus, and is of a thinner and lighter composition; the head has much the appearance of a common star, and compares in bulk to some of the planets of the solar system, being thousands of miles in diameter. Attached to this head is that part of the comet known as the tail, which generally accompanies it. This tail is composed of a very rare medium; it is, perhaps, a fluid

thinner than any gaseous composition we know of, but still it seems to have the power of reflecting light. It has been often observed that when this tail goes between us and one of the fixed stars the star is not dimmed but a very little.

The comet's tail is often very long, sometimes extending out into ethereal space a distance of millions of miles; it seems to not have a uniform size, where it joins the head it appears to be narrower and denser than it is at its extremity, for there it seems to gradually spread out or become more bulky. The width of the tail of a comet has been often observed to be thousands or millions of miles. The tail is always attached to the head on the side opposite from the Sun; this is a remarkable fact, and one which has puzzled the minds of the astronomers "from the time when the memory of man runneth not to the contrary." It is said by the astronomer Dick that the tail of a comet is influenced by a resisting medium in space, which tends to make it go behind its head. This statement of Dick agrees with the observation of others, but does not do away

with the fact that this light gaseous appendage always points nearly directly from the Sun. There is a reason why the tail of a comet should have such a position, and I will endeavor to clearly explain this reason before quitting the subject.

There is another natural feature of a comet which has been looked upon as a mystery during all past ages. This wonderful and long perplexing phenomenon is, that its size differs greatly in bulk when it is in different parts of its orbit.

The orbits of comets are very elliptical, sometimes being so much so that they reach the form of a parabolic or hyperbolic orbit. When they move in either of these two eccentric orbits, they seldom if ever return. Their orbital motion is much more rapid than that of the comets which move in elliptical orbits. They do not seem to belong to the solar system as other comets do, but are wanderers from some other system or else are foreign to all the systems of the unbounded whole, and rest or move through that vast ethereal space

between planets and about worlds at the bidding of nature's laws.

The part of a comet's orbit the more distant from the Sun is called its aphelion; that part nearer to the great luminary its perihelion. A comet is first generally seen in its aphelion, advancing toward the Sun while here, and when it is about to enter its perihelion it is very small, but from this time on until it has passed its perihelion it increases in bulk, and now its tail, which was hardly visible when it was about entering perihelion, seems expanded, and while this appendage points out directly from the head of the comet on the side opposite from the Sun, it spreads away out into ethereal space for millions of miles. As this mysterious messenger leaves its herihelion and goes into its aphelion, it is at its greatest size; as it advances on its way in its aphelion, it gradually becomes smaller. These changes in the size of the head and the tail of a comet or when there is no tail, the seeming expanding and enlarging of its mass when it is in its perihelion, are facts which, though mysterious, have been of interest to all the civilized world for many

years. My reason for there remarkable changes in the size of a comet will be given in the conclusion of what I have to say on the subject.

The length of a comet's orbit is usually very great. Its least perihelion distance is sometimes less than a million or only a few million miles from the Sun, while its greatest aphelion distance reaches very often the incomprehensible extent of billions of miles. From this unequal distance there has come a very perplexing question which the student who has been trying to solve the mysteries of these mysterious ethereal messengers usually put as follows: "If the comet is attracted by the Sun, from a position away beyond the planet Neptune, why don't it fall into the Sun when it comes only a million miles from it? Why does it leave the Sun when it has once come so near it, for that far off distant point again?"

It seems to me that if attraction brings a comet to the Sun, it cannot be attraction that carries it away from that luminary. The force that takes it away must be opposite to the force that draws it to it. All astronomers who have tried to find a law that governs the orbital mo-

tions of comets, seem to have come to no definite conclusion. Their motions, according to authorities I have perused on this subject, cannot be controlled by the same laws that cause a planet to revolve in its orbit. They seem to be of a different nature, and move through the heavens controlled in whole or in part by other laws.

I will hereafter speak of this strange feature in the comet, and give a reason why they move, and why their motions are as they are.

Comets have swept through the solar system ever since observations of the celestial world were first taken by our worthy ancestors. As far as we know, they have always existed, and at an earlier growth of our solar system they may have been more numerous than they are now.

The comet that was seen soon after the assassination of Julius Caesar was very remarkable, on account of its form and brilliancy. The time of its return to perihelion has been calculated by astronomers to be 575 years. Its next return will take place in the year 2255, too late for us to see it, but our posterity

will, no doubt, behold that wonderful messenger.

Halley's comet seems to be the one most famous at the present time. It was discovered in the year 1682 approaching perihelion. This comet is the one seen by Kepler in the year 1607; it is supposed to have appeared at intervals of 75 or 76 years before it was seen by Kepler, and looking over the records, astronomers found that it had appeared repeatedly at intervals of time agreeing to Halley's calculation, which was $75\frac{1}{2}$ years. This calculation or prediction by Halley was better substantiated by the appearance of this comet to perihelion in the year 1759; it came again to its perihelion in 1835, and it is expected again in 1911, when we fellows of this generation who survive the conflicts of this life until then must lay our plans to see this great comet in all its splendor.

In the year 1826, a comet was discovered by an Austrian named Biela, which was found to be periodical, and after some search of former comets that had been seen which compared in every respect to this one, it appeared that it

had often been seen before. Its time of revolution was found to be nearly seven years. This comet in 1846 appeared to meet with an accident, for, during the month of January in that year, the comet had divided itself into two parts, which gradually wandered from each other, and advanced in this position until they were lost to view, away off in its aphelion. At the regular time for its returning to perihelion, in the year 1852, this comet, or both parts of it, (which may be called two comets), appeared again, and when it left its perihelion this time, it seems to have gone for good, for it has never appeared since.

The comet known as "Encke's Comet," is one which has excited a great deal of attention and study during the past century. It was first seen in January, 1786, by Encke, a German astronomer. The time it takes this comet to revolve in its orbit is a little over three years, which is a very short period for a comet to make a revolution. Encke, during his lifetime, took repeated observations of this traveler and found the time of its revolution to continually become shorter. He could find no

reason why this time should become shorter, unless the comet met with a resisting medium in space, which he, as well as other authorities believed would shorten the length of its orbit, cause it to go nearer the Sun, and consequently move more rapidly. He therefore stated to the world, from the facts under his observation, he concluded there is a resisting medium in space. An astronomer by the name of Von Asten has been of late investigating the movements of this comet, and seems to have arrived at Encke's conclusion.

A host of other comets might be mentioned which would be of interest, but my purpose in this production is not to describe all these heralds of ethereal space, but to give reasons for their general physical appearance. I have tried thus far to show what their general appearances are, and now I will attempt to give reasons for those very mysterious natural appearances.

Why do they have such peculiar orbits? Why do they expand and become larger when they get near the Sun? Why do their tails always point from the Sun? Why don't they

go into the Sun when they approach it, if the attraction of that body all the time increases, and what takes them away from the Sun? These are the questions that the professor, the tutor and the student of astronomy have had rung in their ears ever since men have known enough to ask them.

If I could have satisfied my mind with any reasons given that I have ever seen attempting to answer these questions, I would not have spent my time by a long course of study with concluding months of hard work trying to solve these problems of physical science.

After looking about for an example so that I might explain, in a clear and satisfactory way, the cause of the general motions and forms of comets, I think I have at last found a simple and near at hand comparison, by which I may illustrate the cause of the general forms and motions of these mysterious travelers of ethereal space.

Did you ever study the cause of the movements of rain or dew? If you have, you no doubt learned that the water that falls from the atmosphere above us has many times before

been on the Earth's surface, it is always "on the go." Sometimes it comes down in torrents from the on moving thunder cloud and at other times it gently and quietly settles on leaf and flower, from out a cloudless sky, at times we may notice the process of evaporation is going on, and the rain and dew which has descended is being taken up and away, by some fountain of heat, and as it separates and forms into little, inflated globes, each molecule floats up and away. When at last these inflated molecules come in contact with a cold stratum of atmosphere they condense or contract, and when this state of nature exists, they no longer have the power within themselves to keep away from their center of gravity, so they start at once toward the surface of the Earth, and in this way, these little messengers, globes, comets or balloons continue their motion in an endless circuit in their important mission.

How much like the comet is the rain cloud; in one as in the other their little inflated molecules, like their whole gaseous bulks, have their heavier sides turned toward their centers of

gravity; in one as in the other each little inflated molecule, like their whole gaseous bulks, are expanded by heat and contracted by cold; and in one as in the other each little inflated molecule, as well as their whole gaseous bulks, are floating in a medium and go toward their center of gravity or away from it, according to their contraction or expansion.

The comet's orbit to us observers on Earth is very strange. Placing one of these mysterious orbital moving bodies away out at its greatest distance in the aphelion part of its orbit, being 3,000,000,000 miles, in a vaporous or gaseous form, or having its nucleus of a solid, or nearly a solid, composition, the whole bulk having a diameter of 20,000 miles; at that great distance from the Sun, it finds old Dame Nature in this wonderful system of ours drawing it. There is nothing now to hinder it from going, and when attracted it yields to this force and gradually begins to move swifter and swifter in its course; on faster and faster it speeds as it approaches perihelion, and as it draws nearer and nearer it begins to grow larger; it begins to expand from the heat it

receives from the Sun's hot, piercing rays, and from friction which is produced by its rapid flight through that far off ocean of ether, and through the solar system's more dense medium.

The more solid portions of this swift messenger are hurried the faster on account of their greater attraction for the Sun, while the lighter parts lag behind and form what is known as the tail. This tail, as it approaches nearer and nearer to the Sun, on account of friction from the medium it is so swiftly gliding through, and the Sun's hot rays, becomes lighter than the medium it is entering, which medium gradually becomes more compact. Where this state of nature exists, the tail tries to control the head, and as they pass around in their perihelion, the tail appears to, and does endeavor with all its natural power to draw the head out into a lighter medium, while the head, though greatly expanded, and perhaps less subject to the attractions of the Sun than it was when it started for its perihelion, still tries to draw the tail towards the Sun.

The struggle continues, and now when this

swift messenger is about to return to aphelion its great bulk, which was at one time but twenty thousand miles in diameter, if it was in a globular form, would measure two million miles in diameter, and most of this expanded bulk of the comet's composition is in its great tail.

The contest between gravity and heat still continues—till finally heat gets the better of its adversary, and having overpowered it, that great messenger's tail rules its head. The tail becomes master, though the head still contends to have its way, and goes to its center of attraction. The tail by its action seems to be compelled to say: "Follow me; its too hot here; I will take you back to my home; and when I get cooled off, according to our general custom you may bring me here again. Come! come! come!" and they go. The balloon ascends gracefully and peacefully, the arched heavens in all their radial splendor are not jarred or molested by this grand contest between the forces of nature, which we creatures of kindred

appreciation, in this glorious world are permitted to behold.

We lowly creatures, gazers while we gaze.
Behold this grandeur of Dame Nature,s ways;
We can't content ourselves with earthly things,
But in eternal space must spread our wings,
To there explore by light of reason crowned
The whys and wherefores of the sights around.
Content at last we leave that heavenly dome,
And coming nearer Earth, get nearer home.

ESSAY IV.

PRODUCTION AND DESTRUCTION OF WORLDS.

It seems strange to me, but though strange it is true that I have now arrived at a time when I will publicly express my opinion, and as well as I can, give the science of the formation of the solar system.

Oftentimes when we start out on a mission we do not anticipate what our labors will be before we are through. I believe that all branches of science are to the ambition what all lines of trades, occupations, virtues and vices are. When we get really started in a course, and as we proceed, are all the while finding new hope and the expectation of joy and gain, there often becomes in our minds an ungovernable desire to go on.

A person may be led to a great fountain of that precious metal gold, by simply discovering a little of its dust; and, on the contrary, by a discovery of a little of this precious dust, one may be led to the bottom of an empty, worthless pit, in the digging of which he has forsaken friends, spent his fortune and wasted his life. But whether success crowns our effort or not, there is a duty each of us owe to ourselves and mankind, and that duty is to "do something." That high prerogative and universal privilege, which we are all favored with, is that, we all have the right to labor, "we all have the liberty to dig."

One of my first undertakings in the study of physical astronomy was to discover a natural law that would cause the Earth to rotate on its axis in the direction it now is rotating. All was blank and dark at first; but by-and-bye the light of reason shone out upon this dark chaos of confusion, and I was able at length to give a reasonable answer for the axial motion of our sphere. From this axial motion of our globe I went with our planet in its orbit to find why it had an orbital motion, and when I had

fully satisfied my mind, as to what was the cause of its orbital motion, I left this sphere for other worlds, going on and on from one part of this wonderful machine to another, until I had traced out to their very sources the general motions of the members of this grand system. When this was finished there came into my mind that long-important question, that topmost problem in physical astronomy, that question of the past and present, and the one I will now proceed to answer is: How did the solar system originate?

La Place, that genius of a Frenchman; Herschel, that great astronomer who saw so many wonders in the celestial world; Kant, that man of remarkable skill in mechanical laws, and other heroes of the past, have given their understanding of the formation of the solar system.

These gentlemen are remarkable men,—they have each given breadth to men's mode of reasoning, and pictured out in sublime grandeur the way chaos in the beginning may have been changed to cosmos. They are men worthy of all the praise and honor which has

been bestowed upon them. I would not differ with them or either of them if I could possibly agree with them or either of them. I can agree with them in many respects, but in some important principles I cannot understand their philosophy, and, as I have wandered from the old course of astronomers, or have taken my own course since first I began to study the laws that govern the movements in our planetary system, I will take my own course in this intance, and endeavor to advocate only that which seems to me to be true.

The greatest trouble I have found in trying to believe the hypotheses on the formation of the solar system which have come under my observation, is where these theorists attempt to account for the revolution of a planet on its axis, and its motion in an elliptical orbit. The motions of comets, asteroids and satellites cannot be explained philosophically by these gentlemen's hypotheses. La Place's nebular hypothesis has no doubt been the most popular of them all, but how can it account for the rotation of the planet Saturn on its axis at the present time, while its rings rotate about it,

going in the same direction as the surface of the planet moves, and making their circuits nearly as quick as the planet rotates on its axis? How can this nebular hypothesis account for the very eccentric orbits of comets, and how does it account for their going round the Sun in every direction? I will not attempt to show all the reasons why I cannot believe fully in these cosmological hypotheses produced by worthy men many years ago. And now, without trying to abolish their suppositions, or saying they are untrue, I will proceed to explain my understanding of the formation of this world—which has been, and now is (in some respects) constantly but slowly changing—as physical laws of the universe have taught me.

How grand it is to think of our Sun, that central orb, as being the mother and father, the sister and brother, of all the movements in this wonderful system of ours.

I wish you to imagine that in the beginning—after unnumbered centuries of growth—away out in ethereal space a bulk of chaotic matter partly solidified, millions of miles in diameter—which is to be our Sun—is floating

away off under the influence of physical laws. Now it is drawn this way by attraction, now sent that way by its great mass being expanded by heat. While it may as it goes, have an orbital motion with or without this orbit, having a center of gravity and it may also have an axial motion from some natural cause as it advances around in its orbital course. Here it devours a great bulk of lost and bewildered ethereal vapor and there it comes in contact with a lost chaotic wanderer which it consumes, while all this is going on, a wandering bulk of ethereal, vaporous, chaotic composition—which is to be the Earth—sees the light of a star of the first magnitude—the future Sun—approaching. Nearer and nearer it comes, and larger and larger it grows, until it seems to be a great ball of fire. This bulk of wandering chaos which has been unmolested, now seems to be drawn toward that glowing orb, and being unable to resist such a power of attraction, it gradually begins to move nearer and nearer to that great hot center of gravity; but soon it becomes subject to a law, that attempts to carry it away from that

strong, attracting mass, and ere long the tail or main bulk of this cometary traveler will have become lighter than the medium it is entering near that infant Sun. Now when this state of nature exists, those lighter parts of this infant Earth, endeavor with all their natural power to leave that hot center of gravity for a colder and rarer clime, these forces contend for mastery, and the struggle becomes fierce. That great fiery mass of chaotic matter endeavors to devour this smaller bulk, but the opposing natural law prevails, and this chaotic, bewildered, inflated, wanderer, with its lighter, vaporous, ethereal parts in advance, goes away off into the depths of cold, dark, ethereal space. But not there to remain, it will ere long return, and after years of travel away from that great attracting luminary which does never loosen its hold, it will have gradually changed its condition and contracted its volume, it will then move slower and slower, till at last, it will be overcome by the strength of that continually attracting central power and it will advance again toward that hot center of gravity. By going this way in its elliptical course, it

encounters small wandering cometary or chaotic bulks in ethereal space which it draws into its bulk by the strength of its attraction, and so it continues to grow, and go on around that great center of attraction in this way for unnumbered centuries.

That great, massive luminary draws other chaotic bodies to it. Some go around it and then away off in the aphelion part of their orbits to return again in future years. Others on going nearer and nearer get under complete control of the gravitating power of that great mass and are soon swallowed up by that fiery, devouring, monster, never to be seen again, while others come, go around that great center of attraction and go off into space never to return again. After hundreds or thousands of centuries some of these orbital wandering bulks which have performed continued revolutions about the Sun, become gradually more and more solidified, their orbits have been slowly changing and are now less eccentric. Their masses under the law of gravity have become round and now the extreme heat which cause them in one part of their orbits to become a

fiery, molten mass no longer can produce that effect.

These wonderful bulks of chaos have turned to cosmos; and as they revolve about their center of gravity, by a slight change in their controlling laws, they have all taken an orbital course in the same direction their great center of attraction rotates on it axis, and are borne on and on in their orbital paths by the nearer attraction of that great rotating center of gravity, which has gradually—while coming to its present condition, owing to its surroundings—taken up a regular axial motion. They are now held in their orbits, which are almost circular, by a centrifugal force in that great center of gravity equal to a centripetal force in that huge mass. The reason why their orbits are elliptical I will not attempt here fully to state, but will say the principal cause of such a circuit is on account of their cometary nature which they have not entirely thrown off. There are other natural laws that influence a planet to go in an elliptical course, which I cannot here mention, nor is it necessary in the discussion of this subject to give them.

While our planets were coming to their present state of existence they met with nebulous chaotic bulks in ethereal space, which they attracted toward themselves. Some of these bodies, owing to their peculiar composition, were regulated by the same laws that caused the larger bulks to go round the Sun, and consequently these smaller bodies went around their principals, changing into a more solid form as their principals changed, and modifying their motions and changing their orbits to suit each progressive step. As this process of world making went on, and our planets and their satellites were forming, it is very reasonable to believe that while they were coming to their present state of existence some developed faster than others. It seems to me that those of our planets, which in form and motion are most like the comet of to-day, are the youngest, or if not the youngest, they have not developed from a chaotic state like some of the others. The planet Mars may be one of this class, and if such is the case, his inner satellite, if he has one, being in the same natural condition, its rapid motion can be easily accounted for, be-

cause then this swiftly moving satellite would be cometary and planetary, and being of this semi-planetary nature, it would be urged on in its orbit by the laws which control the motion of comets as well as those that control the planets and most all their satellites in their orbital courses. The planets Uranus and Neptune may be in some kind of a semi-chaotic state, and if such is the case, there could be satellites revolving about them, very rapidly, in any direction.

While our planets and their satellites and the asteroids were coming to their present condition from those chaotic, vaporous, ethereal bulks; there were no doubt thousands of just such bodies destroyed. Many were consumed by the Sun; others met with accidents, and were scattered throughout ethereal space; while some others wandered away off into other worlds, never to appear in this system again.

When these planets had come to nearly their present physical condition, it could have been observed that the once great bulk of ethereal vaporons fluid, which had carried them off from the Sun had disappeared, and while their

motion in their orbits had undergone quite a change, this planet Earth—as well as other planets—had constantly been preparing itself for another motion. It is clothed all around now by a dense, deep atmosphere; great oceans of water inhabit this globe; the hot rays of the Sun pour down on one-half of our sphere and greatly expand it, while the other side becomes cold and contracted. As the Earth now hurries on in its course at the rapid rate of over 1,100 miles in a minute, the expanded side of this sphere, in proportion to its weight, receives more resistance from that fine ethereal medium of space, and is moved to the rear, while the heavier side, being more attracted by the Sun, in proportion to its bulk, advances willingly to face that great center of gravity. The motion has now begun, and ere long it becomes regular, and this globe spins around on its axis, controlled by those grand physical laws which give us the opportunity of seeing nearly the entire celestial world in twenty-four hours.

When this great system of ours was forming and coming to its present state of existence, it may have been that some of our planets,

satellites or asteroids, were not in the beginning, wandering, independent, chaotic nebulous bulks in ethereal space, but were a part of chaotic cometary wanderers, from which they separated by some natural law, and when they left their parent bulks of chaos, they may have wandered away off in their own separate, individual orbits, or taken up a certain position near their protecting parent, about which, under the laws that govern the comets' movements, or else, by the physical laws that cause a planet to revolve about the Sun, they took up an orbital motion, progressing in their condition as their principals progressed, and changing their motions as their natural surroundings changed.

Encke's comet, that strange messenger of ethereal space which revolves about the Sun in less than four years, may be looked upon as a young planet or an asteroid, and if it is not destroyed, or does not meet with an accident, it will no doubt, at some future time become a solid body of matter, with an orbit like or similar to the Earth's, and revolve about the Sun in a certain and fixed period of time. This comet's orbit is gradually becoming smaller

and its time of revolution faster. According to my understanding this indicates, that it is becoming more condensed; more of a solid at each revolution.

Biela's comet, which met with an accident in the year 1846, resembled in many respects that traveler, known as "Enke's Comet," and no doubt of it had survived all opposition, had had no wars within itself, continued to grow and thrive according to natural laws, at the present time we could observe it gradually developing into a planet of some kind.

The little telescopic wanderer, known as "Fayes Comet," is without doubt, a young or or an old planet, and is either developing and organizing itself into a condition of cosmos, or else leaving such a state of existence, for a condition of chaos and confusion. As we observe it, how like some of the asteroids it is. The eccentricity of its orbit being 0.55 while that of the asteroid, Polyhymina is 0.33.

There are other telescopic comets that resemble in many respects the asteroids that have very ccentric orbits, among which may be mentioned D'Arrest and Winneck's. These comets

have much the appearance of asteroids, as they go round the Sun in the same direction the asteroids revolve about that great center of attraction and heat, in fact there seems to but a little difference between these small telescopic comets and these small telescopic planets, and for what is cometary to become planetary, or what is planetary to become cometary, as it is swayed in the mighty hands of nature, would be but a natural and expected consequence, and then, after such a change, to become more cometary, or more planetary, would be in keeping with the developing and declining work of nature.

It is not at all probable, but there may be comets that never develop, that never change, and are to-day, and will be 1,000,000 years from now, what they were 1,000,000 years ago. Comets that appear as foggy mist away off in the heavens now, may have been of that thin composition when our Earth was a chaotic bulk in a cometary state. Worlds grow as other things grow. Worlds survive or perish in accordance with their natural surroundings.

My father set out one hundred apple trees

in his orchard several years ago. On visiting that orchard not long since, I observed the condition of several of those trees. "Here," said my brother, "the ten trees in this row are bell-flowers; three of them died the third year; one was gnawed by the rabbits last winter, and was dead this spring; the other six are living and doing well."

I look at the six thrifty bell-flower trees which were loaded with fruit, and then at the dead ones for years standing in that condition, and then observed for a while the one that had died the winter previous. This tree was larger by half than the ones that had died first, and the living ones seemed to be as large again as the last one that died. Why there should be such a difference in these living trees and the one that died but six months before, I could not understand. But my brother soon made the case plain by saying, "You would have known long ago, if you had been around here and taken care of them, that that tree was a runt; it seemed to be dwarfish; it no doubt was stunted in some way, and never developed like the others."

While I have been studying about the growth of worlds, I have thought that the eight planets of our solar system are much like these thrifty bell-flower trees I saw in my father's orchard, which have been able to enlarge their bulks by natural growth. That stunted tree was the slow growth runt, it did not develop rapidly and was in danger of being destroyed by a very slight cause. It did not possess the vigor or constitution of those thrifty ones; though I have seen runts come out as large as the largest, such is not the usual case. A runt planet is one which is not capable of keeping up its growth with others of the same age. It does not seem to have the will or power to draw to and add to itself from its surroundings, as the vigorous thrifty planet does.

Those dead trees may have died from the results of an attack by an enemy or a destroyer in the shape of an insect, worm, gopher, rabbit, beast or man, which often occasion the death of such trees; or else they may have been shaded too much, and the vitalizing fluids that should have nourished them above and below the sur-

face of the ground, were prevented from so doing by the rank growth of vegetation which overtopped and surrounded them. Dead planets are those that have lost their power and energy to become something more than they are. Although the properties of matter in them may be the same as in thrifty planets, so far as attractive laws go, yet from some cause, owing to their condition, they do not have the power to add to themselves from their surroundings, but if there are any changes in their bulks, they are losing, while perhaps some thriftier planet near by gets their loss.

Nature reproduces itself. The thrifty forest tree which we look at to-day has the same properties of matter and life in it that forest trees had in them thousands of years ago. The planet that we say is living and thriving to-day, and which we class as cosmos, may be dead at some future time, envelop itself in a great ethereal vaporous cometary garb and return to its original condition of chaos, whose orbit may become so eccentric that it will ere long, leave its center of attraction—the Sun—and go wandering away off to some distant star through

the deep, dark depths of ethereal space, to develop into a new planet, or disseminate itself about and between systems, there to become the food of aged or infant worlds.

ESSAY V.

PHILOSOPHY OF THE TIDES.

It has been said that an ancient Briton, about fifteen hundred years ago, lived on the southern shore of his island home—which is now known as the southern coast of England—and there, day after day, and year after year, watched the ebbing and flowing of the ocean's tides to discover, if possible, the cause of their motions. There he meditated, there he observed and pondered; till at last, perplexed and confused to the utmost extreme, he one day broke out in a wild fit of anger, after which, the eyes of a raving maniac told of the disordered brain of a semi-barbarian.

The race of mankind from an early existence has labored with all its skill and talent to understand why the tides of the ocean ebb

and flow; to tell why they rise and fall has been the study of the scientist since he first existed. Among those who have labored in this noble cause, we can can point out some who have fallen by the way hopeless lunatics, others in poverty and dirt have gone to their cold and lonesome resting places, pronounced imbecils made so by want and dissappointment, while others have given a spark of light to this once bleak subject and gone to their final resting place leaving wealth, friendship, and an honored name behind them. Of the latter class Sir Isaac Newton is probably the most noted, for he seems to have accomplished more from his study of the tides than any one at, before, or after his day. Sir Isaac's theory of the tides has come down to this generation and is the one most generally taught to the students of our schools and colleges.

Sir Isaac's theory has successfully stood against the attacks of its enemies for more than two hundred years and what there is of truth in it, will, and should, endure the criticism of all ages in all centuries to come.

In this essay I will not give a very full

description of the tides. You doubtless all know how and when they rise and fall and many of you no doubt have felt and observed these wonderful motions.

The tides that face the Sun and Moon are caused by the attraction of these luminaries on this liquid substance which is heaped up on the side of the Earth that faces these attracting spheres. On the side of our planet opposite from the Sun or Moon the tide always rises about as high as it does on the side of our sphere nearest either of said luminaries, consequently when the Sun and Moon act together we have spring tides, which should bring us two high tides a day, but when the Moon is near quadrature, that is about ninety degrees from the Sun; these luminaries act separately, producing what may be called neap tides, which should bring us four low tides a day.

I will not attempt, in this short essay, to give all the special appearances, motions and heights of the tides; nor will I here attempt to show how much greater influence the Moon has than the Sun, in producing these great tides that are ever and always, apparently, trav-

cling from east to west about our globe, doing their best to keep directly under the Sun and Moon, but on account of the numerous obstacles in their way, they very often come far short of their natural inclination.

As the tides pass over mid ocean they only rise to the height of a few feet, but when they sweep up a bay or river that narrows gradually from its mouth, they then sometimes heap up, toward the head of such an ocean harbor, to the height of fifty feet.

The philosophy of the tides as taught from the books of my school days is the same philosophy that is taught in our schools to-day, and this philosophy I will briefly give, for the purpose of finally showing the unreasonableness of some old theories, and the plausibility of a new one, on the cause of the tide on the opposite side of the Earth from the Sun and Moon.

As Elias Loomis' Astronomy is near at hand. I take it and turn to where he discusses the subject of tides in that popular book, and while I read and meditate I decide at last to agree with him in his philosophy, until he at-

tempts to give a reason for the rising of the tide on the opposite side of the Earth from the Sun and Moon. This tide, the learned gentleman says, is caused by these attracting spheres pulling the solid portion of the Earth away from the water that is farthest from said attracting masses of matter, which is consequently less attracted, and therefore left behind to heap up, and so form out of our globe an oblong sphere or an ellipsoid. Such is some of the philosophy of the tides, as taught by Sir Isaac Newton. Such is a part of the tide theory that is taught by some of my old friends, the teachers to some of my new friends, the students of to-day.

That grand old English barrister, Blackstone. has said, "that law is best which is most reasonable," and he well could have added, "that philosophy is best, which is most reasonable."

Closing Loomis's Astronomy, I turn over the leaves of Mitchell's Physical Geography till I come to the place where the author, Prof. Brocklesby, discusses the subject of the tides, and finding he has used the same philosophy

in discussing this subject that Prof.. Loomis uses, I shut the book and look about to find other and, if possible, better reasons for the rising of a tide on the opposite side of the Earth from the Sun and Moon. Soon I have Guyot's Physical Geography before me, and after studying over what this author has to say on the philosophy of the tides, I conclude that Guyot reasons, as Loomis and Brockleby do, until he philosophizes on the cause of the tide on the opposite side of the Earth from the Sun and Moon. When he reaches this part of the subject, he branches off in a strange and peculiar way of reasoning, that does not cease until the author has tangled himself, as well as those who follow him, in the worst webs of sophistry. Mr. Guyot reasons about in this manner when he tries to account for the tide on the opposite side of the Earth from its great attracting luminaries. "As the water on the sides of the Earth is nearer to these attracting spheres, than the water on the opposite side of our globe from the Sun and Moon, it is consequently more attracted toward the center of the Earth, and as this water on the sides of

our sphere is pulled toward the center of the Earth more strongly than the water on the side opposite from these attracting luminaries, it consequently causes the water to heap up or bulge out on that side opposite from these attracting spheres." Can the student understand that? I have given Mr. Guyot's theory a plain and correct showing, and from what I have said as to his philosophy on this certain part of the subject. What does our modern scientist think of it?

When I was a youth at school I devoured many things, with my young mind, that did not exactly agree with the digesting organs of my brain, but as the child swallows sweet oil because he is persuaded it is good, or because the nurse happens to have more muscle. So I took down some unpleasant draughts because I was told they would do me good, or because I was overpowered and compelled to. "The end justifies the means," our teacher would say, and the means, if rightly applied means something to the end.

After some years of patient study and thought on the philosophy of the tides, I have

at last come to a very plain, simple, and to me satisfactory explanation for the tide that occurs on the opposite side of the Earth from the Sun or Moon. And now, after I give my reason for not accepting the theory as laid down by Mr. Gugot, Loomis and others as correct, I will proceed to tell you what I think causes the tide on the opposite side of our sphere from those great attracting luminaries.

I will not take up much time in showing you the absurdities of Mr. Guyot's philosophy; you need only to study his premises to find the weakness of his logic. To make it plain, let me show you how he reasons, "Placing the Moon above the equater at ninety degrees west longitude, it will attract the water of the Earth most at that point, therefore a tide will be raised there. Now on a circuit about said point, at a distance of ninety degrees from it, the water of the earth will be more attracted by the center of the Earth than the water on our globe, about a point on the equator, ninety degrees east longitude, therefore the water at ninety degrees east longitude will be heaped up or bulged out." You admit Guyot's pre-

mises, and where do you get to? Some one answers "just where he wants you." He makes his statement for a purpose and that purpose is to have you believe it without knowing why you believe. Mr. Guyot deals altogether with centripetal force, leaving out centrifugal force entirely, and therein lies his error.

A part of the theory given by Guyot seems to be very preposterous and does it not seem to you that the water on our globe opposite from the side next to the attraction, in the absence of centrifugal force, should be drawn more strongly by centripetal force toward the center of the Earth than any other water on the face of our globe? for it does not only have the center of our sphere to attract it but it has another or other great attracting spheres pulling it in the same direction.

The cause of this peculiar tide as given by Mr. Loomis—being Newton's theory—is a little more plausible than that given by Mr. Guyot. Mr. Loomis says, "the Sun and Moon pull the Earth away from the water on the opposite side of our sphere and consequently leave it heaped up." You may notice that he deals

with centripetal force, separately and alone, and that, in my judgment, is where his error lies, for if he had said, the Sun and Moon, by *centrifugal force*, swing out the water on our sphere on the side opposite from them, he would have penned, or uttered a philosophical truth, that would have been worthy of his consideration.

It is difficult to illustrate, this Newtonian theory, for we cannot find anything that will act the part of the Sun and Moon, in producing tides; but to elucidate. Let us take a rubber balloon, cover it with a thick liquid coating, then let it loose and see where the liquid covering will proceed at once to collect. Will it not rush to the side of most attraction, and face the center of the Earth? What do you think about it? Do you think the attraction of the Earth will draw the balloon away from the liquid surface covering, and leave a tide heaped up on the opposite side of that little rubber ball? Will that liquid form into two tides, or one tide? According to the Newtonian theory, it must form into two tides, but do you really think it absolutely necessary?

On approaching my "philosophy of the tides," I must remind you that I have attempted to explain and clearly show, in my orbital theory, on the cause of the orbital motion of the Earth and Moon, how the Earth swings the Moon about it, and how the Sun swings the Earth about him. This being so, there is consequently generated a centrifugal force from the central sphere, which is equipoised by a centripetal force, in that same central sphere, and so these planets are held in their natural orbits.

Now, my friend, if you will take an apple, tie a string to its stem, and then whirl it about your hand, calling your hand the Sun, the apple the Earth, the connecting string the attraction between the two spheres, and the liquid covering of the apple the water on the surface of our planet, what could you illustrate by such an experiment? Would not the liquid substance on the surface of the apple be swung or thrown by centrifugal force to the side of the apple opposite to the central force? I think I hear you say, "of course it would be."

Now in the last preceding illustration, though I have represented the connecting string

as the attraction between the hand and apple, it does not very well take the place of attraction of gravitation between the Sun and Earth, for if we had such an attraction between the hand and apple, and such a centripetal force equalled the centrifugal force, we would then have on the apple, as on the Earth, two tides of equal height caused by the Sun, one the result of centripetal and the other of centrifugal force.

As we can all easily see why the Moon causes a tide on the surface of the Earth next to her, it is unnecessary to dwell on the known and certain; so we will pass without any delay to that which has been unknown and uncertain, and try to give a true reason for the existence of a tide on the opposite side of the Earth from the Moon.

As the Sun generates centrifugal force by his axial motion, so the Earth generates centrifugal force by its axial motion, and as the Sun swings the Earth about him in its orbit, so the Earth swings the Moon about it in her orbit. The Sun, that great controller, on account of its size, has the greater part to perform in this

swinging contest; though at every revolution the Earth, or either of the planets, make about the Sun, that great luminary is influenced from a direct course by the swinging power of each one of these smaller spheres. As between the Earth and Moon, the Earth does the most swinging, though the contest is much more equal than it is between the Sun and Earth.

As the Sun and Earth pass through the heavens they remind me of a man and a little boy, who take each other by the right hand and advance toward a certain point, the man all the time swinging the boy around him, while the boy is doing his best to swing the man in the same direction. The stronger and heavier power will of course succeed in doing the more swinging. The hold between the man and boy may be called centripetal force, while there is a strong tendency generated by their circular motion to swing off at a tangent, and this swinging off tendency may be called and is centrifugal force.

As the Earth and Moon pass around the Sun, each one by swinging the other with all its might, generates a centrifugal force which

is, of course, felt most on these spheres on their outsides, that is, their sides farthest removed from the attraction of the opposing sphere. Now as there is a centripetal force existing between these planets, and as there is generated a centrifugal force on the sides farthest removed from the opposing sphere, it appears to any reasonable mind, that each of these spheres, on account of their natural condition, should be influenced to take the form of an ellipsoid, and should either of them be elastic or have a fluid substance over its surface, such elasticity or fluid would yield to these controlling laws, and on one side of each of these spheres, it would be attracted to, and on the opposite side driven from, or swung from, a common center, about which each of these spheres revolve.

The centripetal and centrifugal force of the Earth on the Moon, and the Moon on the Earth, are equal, consequently the tide caused by one force should be as high as the tide caused by the other.

I have thus far in what I have said explained the philosophy of the tides in their general or simple form. If I have failed to

thoroughly comprehend and explain the truth; it has not been from lack of labor and determination. I believe thoroughly in the theory I have produced here for your consideration and as I launch it out into the great ocean of thought, I think it will sail proudly on and on unheeding the jeers and sneers of the thoughtless and unharmed by the critical darts of the sophist.

In this essay while I have quite thoroughly discussed the philosophy of the tides, I have not made any complications or combinations caused by the positions of the Sun and Moon, or hinderances and oppositions in the shape of continents, islands and head winds, that part I have left to you, who may calculate and speculate on that part of the subject as you please and when you please.

PHILOSOPHICAL CHIPS.

EXTRACTS FROM THE AUTHOR'S RECENT LECTURES AND DEBATES.

WHAT GOVERNS THE TIME OF ROTATION OF OUR PLANET ON ITS AXIS?

I might say a few words of truth about the time it takes the Earth to rotate on its axis. This rotation of our planet, as well as the axial motion of other planets, depends upon their axial inclination, their distance from the Sun, their bulk of expansive composition, their ability to expand quickly when exposed to the Sun's heat, or contract rapidly when away from such heat, and rapidity of their orbital motion. I do not think it necessary to point out the reason why these conditions of a planet should effect its axial motion. Any one having become familiar with my theory on the axial motion of the Earth should understand why the natural conditions of a planet, I have just mentioned, should affect its axial motion.

POET MILTON. THE BIBLE, AND A RESISTING MEDIUM.

When the poet Milton had grown to full, ripe manhood, he took a tour over a large portion of the continent of Europe, visiting many important places of interest and associating himself in the company of many distinguished men. It has been said that one of these great beacon-lights he had the pleasure of seeing, and visiting, was Galileo, then the astronomer whose late fame had spread all over Europe. With this great character he communed, and finally pleasantly left this worthy man, after receiving a grand store of his philosophy. From his travels on the continent we follow this great poet to England's shores, and thence into that famous city—London—and to his quiet home. In a few years a poem breaks out from its environs and soon its praises encompass the globe. This remarkable production was "Paradise Lost," by John Milton. As an astronomical or a philosophical poem it was in advance of the age, and as a scriptural poem this production has probably never had its equal. In this poem Milton has no doubt used some of

Galileo's philosophy and astronomy, which the poet had endorsed and appropriated to his own use. When and where Milton, in this poem, speaks of the angels, good and bad, flying on and on through the medium of interstellar space, he represents them as having wings, with which they propel themselves through that immense space between Heaven and Hell, and between the Sun and Earth. Is it not impossible for anything to fly unless it has a resisting medium to fly in? From the philosophy of Milton's poem I understand that this great poet and his teachers—including Galileo—believed there is an ethereal medium all through interstellar space, and that this medium is a resisting medium.

Whenever and wherever the Bible speaks of the flight of a spirit to other worlds, or to that heaven above, and where it tells of the ascension of material beings, being borne on away off though instellar space on angels' wings, it clearly leads us to believe that the author or authors of that "book of books" knew or believed there was, and is, and will be, a resisting ethereal medium in interstellar space.

The religion of nearly all people and nations, both of the past and present time, teaches that there is a medium pervading interstellar space through which winged angels may fly.

The glorious light of science radiating from the immortal mind of a Römer who discovered that light passes through an ethereal medium a distance of the diameter of the Earth's orbit in about sixteen minutes, would—if it did not seriously interfere with an ill-founded theory on planetary motion—convince all scientists at once that there is an ethereal resisting motion pervading instellar space.

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THE OUTSIDE APPEARANCE OF THE EARTH.

We all learned the fact from our school books, that the Earth is flattened at its poles, that its diameter is greater at the equator than at the poles, and that this is the result of centrifugal force. When we were taught those facts we were taught the truth, and now with the same philosophy we may believe that the outside of our atmosphere is much farther away from the Earth's surface at the equator

than it is at its poles, it being a fluid there seems no cause to prevent its heaping up by centrifugal force. If the Earth's atmosphere is heaped up at the equator by centrifugal force, why should not the atmosphere of other planets be heaped up at their equators? If centrifugal force tends to throw the gaseous envelope of a sphere above its equator, why is it not reasonable to believe that it has been centrifugal force that heaped up and swung out the rings of Saturn from its equator?

The planet Saturn is the only sphere of the solar system that has visible rings. These rings must be composed of a rather dense fluid or they would not be visible. If visible rings revolve about a planet why should not invisible rings encircle and revolve about it? There may be a ring or rings about our globe or other globes which we in our life time will not be permitted to behold but which, the star gazers of future inhabitants of this planet,—when these rings will have become dense enough to reflect the Sun's light—may see in all their splendor.

KEPLER AND NEWTON'S LAWS OF PLANETARY MOTIONS.

Kepler discovered three laws of planetary motion and Newton added to these three laws by applying to them his three laws of gravitation, these laws seem to me to be all true, they are rules in accord with physical science and are liable to live forever. I will mention but one of them here, and that one is the third law by Kepler which is as follows: "The square of the times of the revolution of each planet is proportional to the cube of its mean distance from the Sun," as I may have before stated, according to my theory this would be the case, the times of the revolution a planet depends upon the distance from the Sun or planet from which it receives its orbital motion. There are some exceptions to this "third law by Kepler" caused by opposing natural laws, but its foundation stands firmly.

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DO PLANETS HELP MOVE PLANETS IN THEIR ORBITS?

This is a question that may be raised among those who discuss the orbital motion of

planets. I answer of course they do, Mercury and all the inner planets help pull along all the outer ones, and the motions of these outer ones tend to influence the inner ones in the way they are going.

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BY WHAT FORCE IS THE MOON CARRIED AROUND THE SUN?

By the same attraction that carries the Earth around that luminary, they are both carried on together by their attraction for the side of the Sun that faces them, and continually moves from west to east on its axis. The Sun so moving about its axis in this way by the strong arm of attraction; all the time influences these globes to follow its moving surface. If the Earth was blotted out from existence, the Moon would no doubt still be, and its motion about the Sun would probably be about the same as it is now. It would of course cease its orbital motion about the Earth, for there would be no Earth to cause it to move in its old way. It might wander away off through interplanetary space and become a satellite of one of our great planets, but wherever it might go, it would

—as long as it remained in our solar system—continue to revolve about the Sun.

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REASONS WHY PLANETS SHOULD MOVE IN ELLIPTICAL ORBITS.

As the Earth is the planet best known to us, we will take it in its present state of existence, and while following it in its orbital course, attempt to give reasons why it should be further from the Sun at certain parts of its orbit than it is at other parts. Attraction for some body of matter away off in etheral space has been said to be the cause of the remarkable changing of the Earth's distance from its center of attraction. All that may be true, but much more may be true, for it seems to me there are some other ways to account for these changes.

The planet Earth is held in its orbit by centrifugal and centripetal force, therefore it should—if these were the only forces that influence its orbital position—be the same distance from the Sun in every part of its orbit.

The Earth has come to its present elliptical orbital motion from a more elliptical orbital motion, and it is now governed by much the

same laws that controlled its orbital motion thousands of centuries ago. Then it was heat and attraction that kept up this motion, and held it in its orbit. Now it is held in its orbit, and moved on in its course, by a repelling and an attracting force, and comes near or goes away from the Sun, as its bulk is expanded or contracted. Contraction causes our planet to approach the Sun, and expansion causes it to go off from that great center of gravity and heat.

From my theory on the orbital motion of the Earth, there may come a law which would account for elliptical orbits of planets or satellites, for when they are at right angles from their principal's axis, and perpendicular to said principal's equator, they are subject to more centrifugal force than at any other point, and therefore liable to be swung out farther from the surface of their principal.

These motions of the Earth to and from the Sun, as well as the orbital motions of other planets, or satellites—when they are once fixed by physical laws into a regular motion, should

and may continue in their orbits, with the same motion for thousands of years.

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WHAT DOES THE MASS OF MATTER HAVE TO DO WITH THE MOTION OF A PLANET OR SATELLITE IN ITS ORBIT?

The larger and heavier the mass, the more power it has, while it turns on its axis to swing its planet or satellite about it. If a sphere like the Moon could be influenced to revolve in an orbit about the Sun, its mean distance from that luminary being but 1,000,000 miles, it would no doubt make its orbital revolution in less time than that great center of attraction would turn twice on his axis.

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SOME SPECIAL FORMS AND APPEARANCES OF COMETS.

Among the special forms and appearances of comets may be mentioned their long beards, the curves in their beards or tails, the number of their beards or tails, and the direction these beards or tails point from the comet's head. These facts depend for their appearance so much on different laws, that the student must

study out the reasons for these special features for himself. From believing that an ethereal, vaporous, chaotic part, may be attracted more to its center of gravity—the Sun—than the head of the comet or its nucleus, as the water of the ocean is pulled toward the Sun and Moon, by the strong arm of attraction, and believing that the comet's tail is endeavoring to pull the head from that center of attraction, as I have somewhere fully explained, and believing that some of these swift messengers may have a rotary motion, you will not find it difficult, if you can so comprehend: with the general laws of motion and gravity—to find reasons for all these special appearances.

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MINOR MOVEMENTS OF THE SPHERES.

What makes these planets incline this way? Why does this sphere have a more elliptical orbit than that one? Why does this one nod, and that other one decline, and why does this one deviate from a direct course? These and a multitude of similar questions might be propounded which would be easier asked than answered, but there are reasons for all these

movements, and these reasons have been or will be discovered.

I will not undertake here to give reasons for the minor movements of the members of the solar system. My object in discussing on questions of physical astronomy has been to find out causes for the principal motions of the members of this great system. To tell why these planets, satellites, asteroids and comets, move on and on as they do, why some of them roll or rotate as they go, and how they may have come into existence, and how they may take their departure, has been my principal object.

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IF THE EARTH CAME TO ITS PRESENT STATE OF EXISTENCE ACCORDING TO THE AUTHOR'S HYPOTHESIS, SHOULD WE NOT SEE SOME EVIDENCE OF ITS FORMER CONDITION?

When we study Geology for ourselves from the books of nature about us, and when we read from the Geologist's book of new discoveries, we become convinced that the Earth was at one time exposed to a melting heat, and that that high temperature left its everlasting impression on our globe. We also learn from these books

of nature and Geology that our globe was at some remote period of its existence, subjected to a very rigorous clime, a cold and frigid place in the expansive heavens, and that winter of terrible frost left its marks on our sphere, which have endured the wear and tear of hundreds of centuries.

How easy it is from my hypothesis to account for this melting heat and terrible frost. For if the Earth's orbit at some remote time in the chaotic past was very eccentric, it may have taken hundreds of years for it to complete one orbital revolution, and while it was completing one of these revolutions it may have gone through various changes of temperature. From that frigid wintry clime, away off beyond the planet Neptune, with its ice-bound crust, it no doubt sped on in its slow but certain course toward that great central mass—the Sun—where it was transformed from that "ice-bound crust" to a red-hot rock-ribbed surface, above which was spread to a great depth, a hot moist atmosphere in which floated about, as great ponderous clouds, evaporated primitive oceans of our globe.

WHAT DOES THE BULK OF ATMOSPHERE HAVE TO DO WITH THE TEMPERATURE ON THE SURFACE OF THE EARTH?

Questions of interest occur very frequently —when we look out to behold the wonderful mechanism of the world around us. When we think that a drop of water will change its temperature sooner than will a barrel of that fluid, we think that which is certainly correct. When you and your friend tell me that a square foot of air will change its temperature sooner than will a square mile of that fluid substance, I will think you speak the truth. If the Earth's atmosphere in this latitude was only one mile high, its temperature would change so suddenly that our nights in mid-summer would be freezing cold and our days burning hot.

The great depth of our atmosphere, about the tropics and the equator of this planet serve as a great moderation, for during the day, the Sun warms this great ocean of atmosphere from its heights to its depths, and consequently when said heated surface of our globe will have turned away from that great center of light and heat it will not—to any great extent—

change its temperature during its short absence from that center of heat.

Our seasons change, as the temperature of the atmosphere changes, for you may notice, when the days grow long and the nights short, there is more time for the Sun with its hot perpendicular rays to warm our atmosphere, consequently it becomes warmer, and when the nights grow long and the days short, we have less of the Sun's perpendicular rays to warm this fluid above and around us and accordingly we notice the mean temperature of the atmosphere becomes lower.

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WHY ASTRONOMERS CAN NOT TELL AT ONCE WHEN THEY SEE A COMET, WHETHER IT IS AN OLD OR A NEW ONE.

I have heard men make this assertion: "If astronomers can't tell certain when a comet is to appear, where it is to appear, and how it is to appear, then they don't know anything about them." Such talk is foolishness. If a farmer has a pig, and that pig strays away for a few years—'though he may have marked it well and recorded such marking—after the lapse of

that time, he may not be able to identify that pig should it happen to pass his premises where he could get a good look at it.

It is impossible for the astronomer to mark a comet, as a farmer can a pig, and he should not be much blamed, if after the lapse of fifty or a thousand years, he fails to recognize it. During that time it may have undergone many changes in composition and bulk, which would cause it to have the appearance of a strange or undiscovered comet, while at the same time, these very changes in its composition and bulk, would cause its orbital motion to change, thereby obliterating every mark by which the astronomer expected to identify it.

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THE AGE OF PLANETS.

When we look at the planets of the solar system, we may think of the age of each one of these spheres, and from some religious or scientific authority, we are apt to conclude, that they were all brought into existence at one and the same time. But such conclusions are not well founded and are undoubtedly incorrect, for we

see by observation that they all differ in appearance and motion. That being the fact, it is also a fact, that the age and condition of a planet always produces such appearance and motion. The planet that has the most eccentric orbit is the most like a comet, from which condition it came or to which condition it is returning. The planet Venus appears to have been longer a member of the solar system than the planet Mars. I think that Venus can be rightly called the older, though possibly, Mars may be as old as she, or older, and the reason he has not advanced in growth may be because he has been checked and stunted and has not had chance to develop, or, probably he may have been what Venus is to-day—though it is hardly possible—and is, from some natural cause, wasting away to return at last to chaos and a cometary state.

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IF A ROTATING SPHERE OF THE SOLAR SYSTEM WOULD CEASE ITS AXIAL MOTION, WHAT EFFECT WOULD THAT HAVE ON ITS DEPENDANTS?

If the Earth would cease its axial motion, the Moon and the Earth would soon be solidly

bound by the laws of gravity into one mass. The Earth's centrifugal force on a body above it would end, as soon as our sphere ceased its axial motion, and when that force ceased to exist there would then be nothing to prevent their uniting.

The satellites of other planets—in the same state of growth as the Earth, would meet with the same fate as the Moon, if their principals should cease to rotate on their axis, and the rings of Saturn would at once fall to the surface of the planet, if that grand old sphere would cease its axial motion.

If the Sun, that great center of our planetary system, should cease its axial motion, our whole system of organized planets, satellites and asteroids would cease their present orbital course, and advance toward that great center of gravity and heat; some of these spheres, would no doubt, go into that glowing orb: others would, undoubtedly, become on approaching that great, hot center, of a chaotic cometary nature, and move about their center of gravity and heat, in very eccentric orbits. While others might return to a cometary con-

dition and go off into deep, unfathomed space, never to be seen in this system again.

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ATTRACTION OF GRAVITATION AND THE MAGNET.

Universal gravitation exists between every atom of the terrestial and celestial world. It is a property existing in all matter which property influences all other matter to come to it.

A magnet is matter charged with electricity. Electricity is of two kinds, positive and negative; it always exists in matter, and may exist without matter or separate from matter, positive and negative electricity attract each other. While negative and positive electricity, when they come in contact with currents like themselves repell. If negative and positive electricity are influenced to become inhabitants of one and the same mass of matter they may each—according to the electric forces about them—take up a certain position in that mass, opposite to each other, and matter when it is so charged with electrity—whether it is

the magnetic needle, a mass of metal, the planet Earth, or any other mass—becomes polarized.

When a planet becomes polarized, it is held in a certain position by these strong electric forces and is not apt to change its position for any slight cause. It may be that the Sun, and his retinue of spheres, are all influenced by electric forces to have their axes lie in a line perpendicular to the ecliptic plane, but are prevented from exactly doing so by opposing forces, which may arise from gravitation, or other laws, that control the motions and appearance of these heavenly bodies, as they move on through ethereal space.

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DO THE TIDES OF THE OCEAN, CAUSED BY THE ATTRACTION OF THE MOON, HELP SUBSTANTIATE EITHER OF THE AUTHOR'S THEORIES ON PLANETARY MOTION?

The evidence, as given by observers, seems to be that the tide raised by the attraction of the Moon does not occur directly under the Moon—that is, on a direct line connecting the center of the Earth and Moon—but it always rises east of said line. Why is this so?

Why does not the attraction of that satellite pull up this fluid instantly and directly beneath her? If the attraction of the Moon acts instantaneously there should be no dragging or lagging behind. If is does not act instantaneously and there is the least holding on—when this attraction gets a hold—then the tide of the ocean, caused by the Moon's attraction, should occur east of a direct line connecting the center of the Earth with its satellite. It being the fact that the Moon's attraction on the Earth's surface is always east of a direct line connecting their centers, it must therefore be true, and the proof clearly shows that the Earth's attraction on the Moon is not directly in a line connecting their centers, but east of such a line, caused by the rotary motion of our planet. Now if this attraction is any distance at all east of a direct line connecting the centers of these spheres, it will cause the Moon to be swung out and away from our rotating globe; thereby generating a centrifugal force, and this force with a centripetal force to balance it, will move that satellite on and on in its orbit about this rotating sphere.

A WAY THE AXIAL MOTION OF A SPHERE EFFECTS ITS PLANET'S ASTEROIDS, SATELLITES OR RINGS.

The philosophical mind can readily see according to my orbital theory of planets, asteroids, satellites or rings, how a fast or slow motion of the principal on its axis, should change or influence its dependents' orbital motions.

If the Earth rotates on its axis but once in forty-eight hours, the Moon would receive less centrifugal force from this rotating sphere and no doubt cease to be what it is now, but if it could in some way survive such a change, and remain in its present orbit, it would not perform its orbital revolution in as short a time as it makes its circuits now.

If the planet Saturn rotated on its axis faster or slower than it does, its satellites and rings—if they survived the change—would move faster or slower according to the motion of their principal. Should the great planet Jupiter rotate hereafter once every twenty-four hours, the time of the revolution of its asteroids —if they withstood the change—would become longer.

If that great central mass of our system should change its axial motion, and henceforth move slower or faster about its axis, then this whole organized system of spheres—if they survived the change—would each at once take up a different motion from what they now have.

As the force that swings a sphere out and on in its orbit is generated by the principal's axial motion, it thence follows, that when the principal moves slower it generates less force, and consequently its planets, satellites, asteroids or rings should move slower about such a rotating sphere.

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HEAT AS A MEANS OF MOTION.

So much has been said about heat as a means of motion that there remains very little to be said on the subject. But as I have, while describing the machinery of the heavens, used heat as a means of motion, I think it but my duty to say something about that power or force that seems to help run this great machine. That long line of perpetual motion inventors have finally concluded, that perpetual motion may be obtained by a current of warm atmos-

phere passing from a naturally warm apartment through some high outlet, to the upper recesses of a naturally colder apartment, while at the same time the colder atmosphere of this naturally colder apartment, finds its way through some low outlet to the lower recesses of the naturally warmer apartment and atmosphere so housed in, will consequently begin and continue to move in a circuit. Just what this kind of a perpetual motion has to do with the continuation of the heavenly bodies' motions, I will not undertake to explain; but I believe this law of motion to be true, and that it acts its part throughout the length and breadth of the heavens.

There are some things in the universe that seem to be indestructible, among which may be mentioned matter and heat. There is the same quantity of matter in the stellar universe to-day that there was billions of years ago, and there is now just as much heat in this grand starry firmament as there has been during these billions of years. This heat may have changed its position at various times, but the average temperature of this great unbounded universe has always been about the same.

These great immortal principles, matter and heat, may change their condition and seem to disappear from a real existence, but then they are only asleep, at rest or awy, and ere long they will arouse themselves and come from their condition of repose or travel; dressed in the same habilliments, performing the same service, and retaining the same immortal elements or principals it is their nature to possess.

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THE GERM OF THE SOLAR SYSTEM.

In my essay on "Production and Destruction of Worlds" I take the Sun as a chaotic cometary, massive bulk, and regarding the Earth and other wanderers of our system in the same natural condition. I thence proceed to give the steps of development of the member of this grand system of ours—thinking of course to go back to such a state of existence—is back far enough. But having been lately asked what causes these bulks to be in such a state, is why I here say something about the germ of this great system.

You no doubt understand my theory on

the growth of worlds, and if you do understand it thoroughly, you will certainly observe that my theory shows very plainly that the growth of the Sun, the Earth, and other planets, and members of our system have been from the first condition of comets, which is the smallest and most rarified state of their existence.

The Earth and other members of our system may be as old as the Sun, but have not developed as fast, therefore he gradually became master and now holds supreme control.

At one time the Sun, that great center of our system, was but a small, cloudy, nebulous bulk in ethereal space, wandering irregularly hither and thither, or having a fixed motion governed by fixed laws. From such a nebulous state it gradually developed by drawing nebulous,chatic matter to it, until it finally became the powerful, massive, chaotic wanderer that I described in my essay on the "Production and Destruction of Worlds."

I believe that a comet that floats away off in the ethereal heavens, and is without a nucleus or head, and appears like a thin cloud, through every part of which stars may shine,

is probably the germ of a future Sun, planet, satellite or asteroid.

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THE EFFECT A RESISTING MEDIUM HAS ON THE EARTH'S ATMOSPHERE AS OUR PLANET PASSES THROUGH THAT GREAT OCEAN OF ETHER.

There have been some persons with whom I have conversed, who produce a rather logical argument against a resisting medium pervading interstellar space, by reasoning as follows: "If the Earth passes through a resisting medium at the rate of 68,000 miles an hour, the front side of this sphere would be swept bare of its atmosphere by that resisting medium, or, if not swept entirely bare the barometer here on the Earth's surface would indicate a great atmospheric pressure every morning at about six o'clock, and also, if the Earth is influenced to rotate on its axis by receiving more resistance in proportion to its weight, on its expanded side that faces the Sun, than it does on its contracted side, which is absent from that luminary, there would certainly be great currents of our atmosphere flowing over the surface of the Earth

from west to east, caused by the resistance of this resisting medium on the upper strata of our atmosphere."

I have thought over these arguments and while I can say they seem rather plausible, I must also say, that those results need not, and do not occur while the Earth passes through a resisting medium. These logicians might as well say, when there is a great storm on the ocean, and the surface of that billowy sea is swept by a furious tornado; that down below that troubled sea, at the depth of a hundred fathoms, the water is heavier than it was when the sea was calm, while great currents of water sweep the bottom of this ocean caused by the atmospheric resistance on the upper surface of this great sea.

The centrifugal force, generated by the rotation of our planet on its axis, gives great resistance to its atmosphere against any outside pressure. While centripetal force gives solidity and firmness to the ocean of contracting and expanding atmosphere above us.

We have all learned from good author-

ities that currents of atmosphere floating over the Earth's surface are caused by the presence and absence of heat. Such, no doubt, is the truth. And if that is true, then there might be an outside belt of atmosphere that is influenced, by some natural law, to travel in an easterly direction about the Earth, on account of the resistance it receives on its expanded side, as it is hurried on through ethereal space, but such a moving belt would be prevented from having any influence on the atmosphere near the surface of the Earth, by denser belts or currents of atmosphere traveling in opposite or other directions.

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MAGNITUDE AND MOTION.

When a heavy sphere one mile in circumference is set in motion, it is not very easily stopped and if it should not receive any additional force, it might make many revolutions about its axis, without perceptibly diminishing its velocity; such being the fact, we may believe that our planet Earth may receive less force at some times than at others to move it on, which would perceptibly accelerate or retard its mo-

tion if it was not a great massive bulk whose motion cannot be quickly changed, and which before any change takes place is acted, upon by an accelerating force that controls its motion in such a way as to neutralize the retarding force, and consequently causes our planet to have continually and constantly a regular motion.

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DOES EVERY COMETARY MESSENGER THAT WE SEE IN THE SOLAR SYSTEM REVOLVE ABOUT THE SUN?

I believe that some comets before they reach perihelion become so expanded that they cease to be influenced more by attraction of gravitation in the Sun, than by the law of mechanics which says: "A vaporous messenger capable of being expanded by heat, when it approaches a hot center of gravity, about which is a gaseous medium, that increases in density as the distance to the surface of such a luminary decreases, when such an approaching body becomes lighter than the medium it is entering —and it may be made so by being expanded by heat—then, and in that case, it is the inclination of such an expanded body to change

the direction of its course, and like a hot-air balloon pull off from its center of gravity, obeying the same law of mechanics that a cork obeys, when it, of its own accord, rises from the bottom of a basin of water."

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THE UNDULATORY THEORY OF LIGHT AND SOUND.

The undulatory theory of light and sound has been attacked from various sources, since my essay on the cause of the Earth's axial motion was first published. Whether that long accepted theory will receive serious damage or not, from these attacks I cannot say. Should the new theory, which seems rather plausible, ever take the place of the old one; I don't see how it can in any way affect my system of physical astronomy, for it claims the existence of an ethereal medium throughout interplanetary space, the same as the undulatory theory does.

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WHAT KIND OF AN AXIAL MOTION HAS THE MOON?

Having spent considerable time studying the motions of the Moon, I think I ought to be able to tell how it moves and why it moves.

If the Moon rotated on its axis, its principal motions would then be one more than those of the Earth. These motions of the Earth are three: first, on with the Sun through ethereal space; second, around the Sun; and third, about its own axis. While the moon goes with the Sun through ethereal space, around the Sun and around the Earth, and, can I add, around its own axis? I think not, for if our Earth should continue its orbital motion, and cease at this moment to rotate on its axis, would not one side of our planet continue to face the Sun? And while such side of our planet continued to face the Sun, you and I and the rest of humanity would say, the Earth does not rotate on its axis. If we would say that of the Earth, why not say that of the Moon, for it always has the same surface facing the Earth, its center of gravity. No doubt the Moon has been in that position so long, that its hemisphere next to the Earth has become heavier, which may cause it to be drawn the stronger by attraction of gravitation of the Earth. If there is any power in this planet that holds one side of the Moon towards it, then it seems to me, it cannot rotate

on its axis any more than an apple does when you tie a string to its stem, and you whirl it about your hand by that string. That the Moon's surface is held in its position by the mastering power of the Earth, is undoubtedly true, and if it is so held, and the Earth sways it in its orbit, then the only axis it turns on is the axis of its orbit, about which it revolves.

It is not the nature of a planet to rotate on its axis unless something turn it. From a long earnest study on this axial motion question, I have never yet found out any reason why the Moon should rotate on its axis, but without much study, I have repeatedly found reasons why it should not, and can not, and does not have an individual axial motion like the Earth's.

The Moon has no atmosphere. It is destitute of this life-giving gasseons fluids that envelop our globe. If it had an atmosphere of any considerable depth it would without doubt have some kind of an axial motion, but on account of its changing relative positions between the Sun and Earth, such axial motion would be very irregular.

HOW THE ETHER OF INTERSTELLAR SPACE IS CONDENSED BY THE PRESENCE OF MATTER.

Since my theory on the general forms and motions of comets was published, I have occasionally been asked why the ether in interstellar space is denser near a body of matter, as the Sun or the Earth, than it is away off from these centers of gravity? The reason why this should be so is very plain, and any one who thinks earnestly may understand it.

If I should say that the Earth's atmosphere or the Sun's atmosphere is heavier near the surface of these spheres, where it is very much warmer than in regions of atmosphere far above such surface, the honest student of philosophy would say, I am correct, and saying and believing I am correct in such a statement, he will without doubt say I tell the truth when I say, that the ethereal medium that pervades interstellar space, and in which, and through which, the on moving Sun, with his revolving and rotating spheres, move in glorious and glowing splendor, is contracted the most, and becomes most heavy, where, and when, it is nearest to the strongest attracting sphere.

These attracting spheres cause their surrounding ethereal mediums to become most dense when, and where, their spheres have the slowest orbital motion, as they advance on in their endless circuits through it.

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A REASON WHY THE SUN AND OTHER BODIES IN ETHEREAL SPACE SHOULD MOVE.

Take the Sun, planets, satellites, asteroids or comets, in facts, any bulk of matter in the stellar universe, that has an orbital motion, and we find a reason why it should continue such a motion, as it speeds on in its course through the ethereal medium that surrounds it.

I wish you to observe the Sun accompanied by his system of spheres moving on, and on, to the unknown and unseen beyond, as he enters the ether of the stellar universe, the either near him becomes more contracted than either further away, and the medium he has just left more contracted and denser than the medium he is just entering, which is caused by attraction of gravitation in that great mass of matter, condensing most the ether it has been the longest near. That being the fact, does it not appear

clear to you, that when this denser medium, closes in behind a moving sphere that is entering a rarer medium, said moving sphere will be forced on in its course by the action of said denser medium?

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AXIAL MOTION OF THE OUTER PLANETS.

Admitting that the planets, Uranus and Neptune, rotate on their axes in nearly an opposite direction to the axial motion of the Earth and some other planets; what is the reason for such an axial motion? I beleve I have hinted at an answer to that question somewhere in an essay where I have said, "the outer planets may be more cometary than the inner ones." Such being the case, the light gaseous medium, that envelopes a comet and extends out from it on the the side opposite to the Sun, will of course, be on the opposite side of these planet pointing from the Sun. A planet in such a chaotic condition, according to my theory on the axial motion of the Earth, will be influenced, by the resisting medium of interstellar space, to be moved back on its light and bulky side contin-

nally, while the side facing the Sun will necessarily move in the opposite direction, and so move, as they are supposed to move, carrying their satellites with them.

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WHAT KEEPS SYSTEMS AND THE MEMBERS OF SYSTEMS APART?

No doubt electricity, centrifugal force and heat are the natural powers that keeps suns, planets, satellites, asteroids and comets apart. Just what electricity does, we may not fully know, but we do know that bodies charged with like electricity repell. The part centrifugal force performs, I have fully shown in an essay, and if you believe, when two spheres of equal size, four thousand miles apart, and moving in opposite directions, are in conjunction with a body, apparently at rest, that the body apparently at rest, will be influenced to go in the direction the nearer of said spheres is moving, then, and in such a case, you can say you believe in my theory on the orbital motion of the Earth and other planets. Now, as for heat, I think I have discussed at length elsewhere, how it effects the heavenly bodies,

but will try here to enlarge upon my theory on this subject, by telling you I believe that when the members of this system, by some chance, become warmer, consequently more expanded than usual, it will be inclined to go from the Sun, or suns, that warmed it, obeying the same natural laws that the comet or the evaporated molecule of water obeys.

When a comet, as it passes through our system, happens to come near a planet, it is not much drawn from its course by the attraction of that planet. A reason of this is because there is a great amount of heat about a planet which, in some cases, would make it impossible for it to get to some of these spheres. Such being the fact, I don't see why a hot planet should not effect a comet in the same way that the Sun does.

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DO PLANETS HAVE COMETS?

Is it not reasonable for us to believe that planets have cometary messengers revolving about and belonging to them? The Earth may possess some of these ethereal travelers, which are invisible to us until their destruction, when

their material parts approach the Earth's surface as meteors, areolites, or shooting stars. Compare Jupiter with the Sun. They are very much alike, although Jupiter is so much smaller than that great center of light and heat. The Sun has satellites and comets and I believe Jupiter has satellites and comets. And as for their motions, I believe and I think you believe that both Jupiter and the Sun have an orbital, as well as an axial motion.

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UNDISCOVERED SATELLITES.

From what I have learned by my study on the physical construction of the universe, I have come to believe that satellites may accompany our planet and other planets, which we never have seen on account of their diminutive size, these little globes, which were probably once little comets, go around these planets in the same direction the larger satellites revolve about their principals, and it may be that the destruction of these little wanderers is one source of meteors, areolites and shooting stars.

DEPTH OF THE EARTH'S ATMOSPHERE.

Our learned opponent says: "No! no!! the Earth's atmosphere is not thousands of miles deep at the equator, nor does the presence of the Sun increase its depth several hundred miles, therefore your theory on the cause of the Earth's axial motion won't pass inspection."

Well, dear sir, that's too bad, not too bad for the theory, but too, too bad for the one who will not or cannot comprehend it. The theory is all right, and if you, with all your learning, would convince us that the Earth's atmosphere at the equator is only fifty miles deep and that the presence of the Sun only expands it so that its depth becomes about one thousand feet more than fifty miles, we would still believe in our theory on the cause of the Earth's axial motion in spite of the arguments of the profoundest logician of the age.

Our theory does not depend for its existence on the statement: "The Earth's atmosphere is several thousand miles deep at its equator and at noon, directly under the Sun, it is several hundred miles deeper than it is at mid-

night on the opposite side of our planet." This is simply a statement, supported by good authority, and we think it comes as near the truth as any other statement on those two questions can, although it does make our theory seem more plausible.

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